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PART I

THE SOCIAL CONSEQUENCES OF AUTOMATION

FOREWORD

MICHEL CROZIER and GEORGES FRIEDMANN

Many intelligent people are astonished at the curiosity, the intense emotion even, which is aroused by the first descriptions of possible developments in the near, and especially the distant, future in the field of automation. The general public's infatuation with this word 'automation' may appear to be a fashionable whim and it is easy to point out the exaggerations, illusions and even misunderstandings to which it gives rise. It is not surprising that the birth of such a *myth* should shock scientists and the industrial organizers concerned, and an extremely interesting critical analysis of this myth might be made, as advocated by Mr. Gass in his general survey of current research on automation,[1] which would shed light on certain elements of our Western cultures.

Although it may be wise to remain sceptical toward the illusory hope of a golden age within our reach and toward the fear of unemployment, which the same people usually experience simultaneously, it is possible that this sensitivity of the general public, however blind its reactions, may have enabled it to detect a vital turning-point in the history of our societies. In such a situation, the task of the sociologist is to try to understand such hopes and fears and to analyse the significance of their causes and effects, rather than to criticize clumsy efforts to express them.

It is within the context of this undertaking, somewhat hazardous—since we have as yet few reliable data on which to base our judgement—but nevertheless absolutely necessary, that we wish this first series of contributions to research on automation by international experts to be considered.

The field dealt with in this series is very clearly defined. While it is certainly difficult to work out a comprehensive definition of the term 'automation', it is now the general consensus of opinion that it covers the following three major sectors, where technological progress has been particularly rapid and spectacular:

1. Integration in a continuous production line, through which the product passes without being touched by human hand, of various manufacturing operations hitherto carried out separately.
2. Retroaction or automatic regulation devices equipped with servo-systems (feedbacks or closed loops), enabling the actual result to be adjusted to the result anticipated.
3. Electronic computers and selectors capable of accumulating a very considerable amount of information and then, on the basis of the latter, of carrying out a variety of mathematical calculations, including the most com-

1. See page 70.

plicated, such as those, for instance, effected by the translating machine described by Dr. Booth.[1]

What is there really new about all these techniques? It can be claimed that there is nothing revolutionary about them. Many automatic control systems have been used in industry since the famous governor of James Watt and, from Blaise Pascal's computer to present-day electronic selectors, there has been a long series of improvements and inventions. Such a claim, however, is only superficially justified. Of course all the theory, which has led to recent practical progress and which now enables us to foresee a great many other steps forward, was already known. We are not dealing with a discovery as clear cut and spectacular as that of the steam engine, electricity or atomic energy, but, as often happens in the field of technology, with an accumulation of apparently quantitative progress which may lead to a sudden qualitative advance or to progress of a different kind.

What is puzzling about automation is that it does not provide Man with a new instrument or give him some definite material power, but, as Mr. Diebold points out, a method and a new way of tackling production problems, and those inherent in the organization of production.[2] That is why it is perhaps more difficult to foresee its effects, but that is also why such effects should become immediately apparent to us at the social level. We certainly cannot expect to have 'press-button' factories in the immediate future. However, the fact that there already exists a model on which specialists in industrial organization can begin to base their thinking is likely, in a very short time, to change radically our ideas on human labour. Whereas the earlier industrial revolutions were considered at the time primarily as a series of discoveries, of inventions and practical applications with certain inevitable economic and social consequences, the changes which automation appears likely to bring about strike us immediately as a reorganization, already partly conscious because it is governed by techniques belonging to our production system.

What proportions will this reorganization assume? That is the real problem which automation puts to social scientists. Of course, taking a short view, it is obvious that the chances of the new techniques being applied immediately are slight. They might just possibly affect 8 per cent of the industrial manpower in the U.S.A., and yet, according to certain experts, that country is by far the best off in this respect. Taking a longer view, however, it does indeed seem that a growing number of workers and the whole of our social system will be directly or indirectly affected. And to what extent? It is impossible, at this juncture, when the first attempts to determine the facts have only just been made, even to begin to outline any convincing answers. Nevertheless it is possible, on the basis of the preliminary research reviewed by Mr. Gass and by making a more thorough analysis of the new situations which are gradually taking shape, to define the type of problems that will arise. These problems fall under two main heads: problems affecting the man on the job and the economic and social problems of society as a whole, or, to quote Mr. Gass, those which are the immediate result of the growth of productivity and those which are the consequence of the complicated interplay of technical and human factors.

1. See page 55.
2. See page 37.

THE EFFECTS OF AUTOMATION ON THE WORKER

The importance of automation is most striking at first sight in the profound changes which it works in the position of the man on the job and in the actual nature of his work. These changes affect almost all aspects of work, from professional qualifications to the actual conditions in which the work is done, the systems of wages, and the relations between the different groups.

Like all important technical changes, automation results first in the transformation of the corresponding human tasks and the qualifications required for those tasks: on the one hand, many old occupations disappear, new ones come into being, and qualifications are combined or reconstituted, and on the other, there is specialization. It is obviously impossible for the time being to keep an account of all these different happenings. Certain general trends, however, seem to emerge. First of all, there is a decrease in the number of jobs where the tempo of work is directly or indirectly governed by the machine. The fact that transfer machines and systems of control by retroaction have come into general use means that the jobs of many specialized workers, whose sole task was to feed machines and evacuate or control their production, have been abolished. All these jobs were certainly among the most arduous for the workers concerned. Here, the work of psychosociologists and physiologists led to the same conclusions: the tempo imposed is often very difficult for human beings to withstand and has disastrous psychological, and even physiological, effects.

Conversely, there will be an appreciable increase in preparatory and maintenance work. Such jobs are naturally more skilled, but they do not necessarily call for the same type or degree of skill as those of the skilled workmen employed at present. They are far less independent jobs, much more interlinked with those of the engineers and research offices. A new maintenance specialist has more theoretical knowledge and less experience and initiative than the former repairer-mechanic. The lives of skilled workmen are also likely to be transformed by the introduction of electronic controls on machine-tools.

In offices, the advent of large computers and selectors is going to make it possible also to suppress a certain amount of routine work, the tempo of which was not, of course, dictated by the machine, but which was already standardized and governed by very strict rules.

Mr. Naville concentrates on this development in his study on the structure of employment. According to him, the greatest number of new jobs will be on the maintenance side.[1] Mr. Gass quotes two examples from recent research in support of the same theory, and Messrs. Klimenko and Rakovsky, in their article on automation in the Soviet Union, claim that, generally speaking, automation raises the level of the qualifications required of workers.[2]

What, in general, will the effects be? They may be of various kinds and even contradictory. Automation may lead to job enlargement or, in other words, to a recombining of piecemeal tasks. Once the routine work has been automated, the same person can take responsibility for a whole cycle of operations. An office employee can thus take over all the operations affecting a series of customers' accounts, which had hitherto been the subject of various specialized tasks and which are now carried out by the computer. Thus, in an example

1. See page 16.
2. See page 44.

from America quoted by Mr. Gass, the workmen employed on the maintenance of a thermic plant have now been regrouped in independent teams, each responsible for a complete production unit, instead of being divided up, as they were before, according to the special skills required at the various stages of production. However, these new forms of organization need not necessarily be adopted. They have called for the recruitment of large numbers of supervisors and considerable efforts in the field of professional training. It is of course automation that has made them possible, but other policies could be followed, and indeed have been followed in other circumstances. The choice between these various policies seems to depend far more on the traditional structure of firms and the manpower at their disposal than on technical necessities. However, the effects of automation on the internal organization of workshops and offices have only just started to be visible and it is probable that, in making the tremendous and henceforth necessary effort to reconsider all these problems, greater importance will be attached to the human factor. The very success of this effort will depend to a large extent, as will be seen in the following pages, on the willingness of employees to co-operate. Any human investments made with a view to adapting the work to the men are likely to prove profitable, although from the technical point of view they may appear to be costly.

With regard to the actual working conditions, two types of general effects are already clearly discernible. First, there are certain very considerable material improvements, resulting from the abolition of a great many arduous, unhealthy or tedious jobs, and secondly, considerable progress has been made at the same time in the matter of security, which more and more will be assured by automatic controls; thus, work will in general become cleaner, safer and less tedious. The Soviet authors, Messrs. Klimenko and Rakovsky, lay particular emphasis on the advantages of automation in this field. On the other hand, however, night work seems to be a frequent and somewhat heavy burden. As things now stand, the cost of the new equipment is such that it can pay its way only if work continues, non-stop, 24 hours out of 24. Needless to say, the system of shifts, which will probably be extended, imposes a very heavy, almost unbearable, burden on those subjected to it. Mr. Gass quotes several studies on the subject, undertaken in England and America, which show how important this factor is from the social point of view. A reduction of working hours, which increased production will probably make possible, is perhaps the only measure that can lighten this burden.

Another more fortunate effect of automation is less often perceived; this is the effect of automation on wages. It is likely, however, to be of very great psychological importance. In most existing wage systems, an attempt is made to establish a link between the wage and the output of the employee concerned. Work is measured by very precise standards, the aim being to secure, with the promise of better earnings as an enticement, the maximum output at a financially advantageous rate. However, a study of workers' incentives has clearly shown how lamentably all these systems have failed. Whatever form workers' resistance may take, it is seldom that the majority of wage-earners behaves reasonably, rather they adopt the opposite view. But automation, by putting an end to the individual relationship between output and worker, henceforth rules out this method of stimulation, to which recourse was still had, and, at the same time, it tends to restrict one of the causes of permanent antagonism between management and staff.

We should not, of course, be over-hasty in proclaiming the disappearance of work measured by output. Mr. Naville makes a point of warning us about that. He thinks it more likely, on the contrary, that the concept of individual output will be replaced by that of collective output and that, as regards remuneration, increased importance will be attached to the responsibility carried by each work station. Yet the measurement of individual output was, after all, a means of controlling work impersonally and automatically. If it were to disappear, would it not become necessary to resort to still more distasteful methods of supervision and coercion? After all, the discipline imposed by the output system may be considered as an advance over the arbitrary and dictatorial paternalist system which it replaced. In fact, automation also leads us to reconsider the problem of human relations within workshops and offices.

What are the new aspects of this problem? First of all, the abolition of many work stations with semi-automatic machines, the centralization of controls and the formation of far larger maintenance teams is going to mean, for a considerable number of workers, the end of isolation in their work and a far richer and more active social life. Together with this social life, on the other hand, will go greater interdependence between individuals and groups and, as Mr. Naville put it, a new integration of the men involved in the system. And this brings us to the problem, more vital for the firm, of discipline. As soon as the tempo of work is no longer set by the machine, the part played by the man in charge becomes far more important. This change is particularly marked because the great complexity of automated concerns makes it essential for tasks to be co-ordinated exactly and for more responsibility to be shouldered by those actually doing the work. The burden will fall particularly on junior foremen, but this situation can be met, either by strengthening their authority and giving them greater powers of supervision, or by trying to transform them into more responsible heads —leaders rather than supervisors. The real point is whether fear or community feeling is more likely to bring about this necessary interdependence. It seems certain that, in view of the new responsibilities which will devolve upon those on the job, the good will of the workers will tend to become the determining factor and it will become increasingly difficult to continue with the old system of supervision. Such a change of policy, however, will necessitate a thorough recasting of the system of human relations within each firm. The whole Taylorian system was based on the idea that, in firms, the rule of men could be replaced by machine administration. Of course, for a long time now, many firms—and particularly all the most progressive—have rejected that assumption; but practice still lags far behind. It is probably technological progress which will finally impose the total rejection of that idea, under whatever social system.

This democratization and decentralization of discipline, which is usually accompanied by still greater centralization of administrative management, will become all the more imperative because the success of the technological changes within the firm brought by automation, will, to a large extent, depend upon staff co-operation, since the latter will have to make a very great effort to train and adapt themselves. It would appear, then, that the latest industrial revolution will be of considerable benefit to all kinds of firms and organizations which have succeeded in creating among their staff a sense of co-operation and responsibility.

One of the great novelties of automation, however, is that it affects perhaps even more directly the position of management; Mr. Diebold lays special

emphasis on this aspect—to his mind an essential one—of the problem. If a firm is to adopt advanced forms of automation successfully, its management must make up its mind to change its methods, and even its outlook, radically. It must remember that the whole point of the new techniques is not to economize on staff, but to enable the firm as a whole to do a better job and the management itself to direct affairs in full knowledge of the facts, with all the necessary information available. What counts is economy due to wise decisions and the best possible use of means, rather than each individual worker's output. Viewed in this light, automation tends to become a means of enabling managers to solve their problems rationally, instead of intuitively as hitherto. But, as Mr. Diebold points out, this does not mean that control of management is going to be seized by automation 'technicians'. Quite the contrary—the contribution of technicians will be to make the duties of management clearer and more specific and to enable the manager to confine himself to his own particular tasks. However, in almost all cases, this will make it necessary to reconsider aims and methods. And, in this instance also, the problem of opportunities for co-operation and team-work will be of prime importance.

THE EFFECTS OF AUTOMATION ON GENERAL ECONOMIC PROBLEMS

It is, of course, in the economic field that automation has so far aroused the greatest fears and, at the same time, the greatest hopes. We would not wish to enter into a dispute in which personal leanings towards optimism or pessimism explain attitudes far better than the facts. We simply wish to make a few remarks concerning the types of problems which our societies will have to solve and to forecast some of their possible effects.

As with all earlier technological progress, the first result of automation is, of course, to increase productivity and reduce direct and indirect labour costs. The figures usually quoted as examples are certainly not accurate, since they do not take indirect costs into account; but, in any case, the gain is considerable. Many facts quoted by Mr. Gass and mentioned in the articles by Mr. Naville and Mr. Einzig enable this observation to be verified. It would probably be wise to remember Mr. Diebold's theory that the advantage of automation might well ultimately prove to be that it made management far more efficient, rather than that it economized on labour. Finally, however, Mr. Einzig's very detailed economic analysis shows that, although automation may not inevitably lead to unemployment, it is only in expanding industries that it can be introduced without causing difficulties of a social character. Similarly, movements of manpower on a national scale are inevitable and they can be effected without a crisis only if the whole economic system is in course of expansion. The example of earlier 'industrial revolutions' has proved to us that there is no technological unemployment as such, but a series of crises due to adjustment difficulties. Far more than unemployment as such, the fundamental problem will be how to overcome these crises and how to avoid the extraordinarily high price of earlier crises.

What are the new factors, as compared with the situations in the eighteenth and nineteenth centuries? There appear to be a certain number of contradictory phenomena. On the one hand, it looks as though there will be a greater speeding-

up of purely technological progress, at least in the more advanced countries. It may also affect far more people, since traditional occupations now take a much smaller place. Further, economic systems nowadays are far more complex and unstable. On the other hand, however, there is no comparison between contemporary knowledge of economics and planning and the relative ignorance of 150 years ago. All the social groups which would be affected have been mobilized beforehand. At all events, there is no longer any possibility of that sort of blind tussle which proved so deadly. Viewing the problem from a slightly different angle, it might be said that the great difference between the present changes and those of the past two centuries is that the sort of auto-regulation of economic activity, due to the existence of the old competitive market in a society of small and average producers, has disappeared. The upgrowth of the large complex organizations which are characteristic of the twentieth century render technically possible (and, at the same time, absolutely essential from the socio-political point of view) anticipation and planning, of which there may be a great variety of forms, but all with the common characteristic—that of being conscious.

Despite their power, big modern concerns are in fact relatively vulnerable. The cost of a strike in an automated firm will tend to be far higher: the stopping of work for any length of time may become disastrous with such ruinously expensive equipment. Further, as we have already pointed out, a change in the duties of a firm's employees requires a general spirit of co-operation which could not be built up in the face of violent disputes. All these factors will drive big firms to adopt a more flexible policy and to agree, more and more, to discuss measures for the planning and ordering of the social effects of automation with trade union organizations.

The trade unions, for their part, will see the conditions governing their action transformed, and their strategic position in the firm may be improved. However, as Mr. Einzig points out, the power of the large trade unions of manual and skilled workers will be diminished and, very generally speaking, the qualified, rather than non-qualified, workers are likely to gain preponderance. Further, trade unions will be liable to be more influenced by the arguments of the supervisors and managers of firms, because they are, owing to the very nature of their work, better integrated in the life of the factory. At the same time they will, above all, tend to turn their attention to employment and readjustment problems, going beyond the scope of firm and industry. In this new context and when discussing these new subjects, they will be obliged increasingly to consult social scientists and have recourse to social science methods. All these different factors will force them to reconsider the problem of their internal organization, in order to maintain contact with their members, but at the same time they will urge them, as employers do, towards a general policy of co-operation.

Of course, even in the most advanced countries, such collaboration has not by any means been achieved, but it must be understood that this is, in fact, the most important problem raised by automation. Our societies have arrived at a stage where they are beginning to be really aware of their development and where such development is no longer possible without conscious social control. And finally we are faced with a choice between dictatorial planning imposed from above, with all its inherent dangers of waste, inefficiency and passive, or even active, resistance, and voluntary planning, undertaken jointly by the various groups concerned.

The fact that, in our Western countries, the most powerful deterrent to the progress of automation is human resistance—whether on the part of employers, who are afraid to run too many risks, or on the part of trade unions, who refuse to agree to any new development from which the workers might suffer and who are capable of paralysing such a development very effectively—can finally be considered, from this angle, as a favourable factor. It may be felt, indeed, that the fears of the pessimists are groundless, in so far as progress itself is liable to be slowed up, or even brought to a standstill, as soon as any particular group proves incapable of adjusting itself. In that case, the sole victims of automation would then be the nations which, through the play of particularly powerful forces of resistance, fell ever further behind other nations and suffered the economic, social and psychological consequences which such a failure entails.

THE EFFECTS OF AUTOMATION ON GENERAL SOCIAL PROBLEMS

The general effects of automation are not, however, confined to economic life. Many other vital aspects of our activities and institutions are liable to be affected.

Let us take education, for instance. In the long run, changes in techniques inevitably call for a considerable revision of education at the various levels. An effort has to be made to train an increasing number of specialists in the new techniques and the proportion of such specialists will tend to go on growing. People are already complaining, in every country, of the lack of engineers, which appears to be the most immediate factor explaining the slow progress of automation. Moreover, quite apart from this training of young people, we shall also have to ensure the re-training of all the staff already engaged in production, from the ordinary workers to the supervisors. A whole process of education is essential, in order not only to ensure the smooth transition of a firm from the old system to automation, but even to make it at all possible. Finally, there is another problem, the social effects of which may not be at once apparent, but which we think is nevertheless of great significance: the problem of opportunities for promotion.

Owing to the complexity of the new techniques, a theoretical university education tends increasingly to carry more weight than apprenticeship and 'on the job' training; this is likely to make promotion more and more difficult and to reduce social mobility. This effect runs counter to the trend towards establishing a closer relationship between the more competent and responsible workers and the research offices, which seems to be one of the conditions necessary to efficency in an automated factory. To remedy this situation a great effort will have to be made, within the firm concerned, of course, but particularly outside it. In our school system it should be possible to raise the level of primary education, so that workmen and employees do not lose all chance of being able subsequently to get beyond the level of the man who actually does the work, within the context of the new techniques. The raising of the school-leaving age, which will probably be one of the indirect consequences of the growth of productivity, should provide an opportunity for this additional education. For the time being, of course, shortage of teachers and present financial practices make this an unrealistic programme. It is quite easy, however, to imagine that the introduction of automation may have strikingly opposite

effects in the case of employees capable, owing to previous education, of adjusting themselves to technological progress and taking advantage of it, and in the case of employees experiencing readjustment difficulties and finding themselves irrevocably condemned to remain executants.

Nor should we overlook the problem of the education of managers, or, taking a more general view—since the problem arises, whatever the economic system may be—of heads of production units. The data and powers of control with which automation supplies them will change their duties and make it far more difficult to train and select them.

If we now consider the question of leisure time and cultural life in general, we shall discover similar revolutionary changes. The length of working hours, holidays, retirement and recruitment age will naturally be quickly, or fairly quickly, affected by the increased rate of technological progress. It is to be hoped that such changes, formerly the fruit of victories won by workers after years of bitter struggle, will be more and more the result of negotiations and even of joint planning of production conditions. However, these changes themselves will affect our everyday life. By freeing man from the obsession of work they will give him time to lead a social life and to make more active use of his leisure. Thus the problem of leisure will become more important than ever. There is, of course, no reason why confidence should not be placed in the initiative of future generations, who will probably manage to find ways of developing their personality and expressing themselves as independent human beings in any hours or days of freedom at their disposal. It is impossible, however, not to be disturbed by the development of automation and irresponsibility in the sphere of leisure. Here again, we are faced with social control problems. In cultural and economic fields alike, we have escaped from the reign of competition and automatic rules. Our societies must now make a more conscious effort to give the individual means of freeing himself and not simply momentary compensations. The social sciences can play a very important part here by revealing the public to itself and to those who have undertaken to satisfy it. In this way, it is to be hoped that writers and artists will endeavour to think more about the effect which they produce and of the public which they serve.

In all fields, automation seems to offer us thrilling prospects, risks and difficult choices. However, it is generally a mistake, in our opinion, to base views on automation on a subjective idea of the future state of society. The problem is not in fact a moral or a static one, that is to say: Will the new society which we expect to see emerging from technological progress be good or bad and should we therefore fight for or against it? It is really the problem raised by transition from one type of technology and economic and social balance to another. It is the problem of the human cost of such a change, the problem of apprenticeship and new jobs.

How are these problems to be solved? Are our societies capable, or even properly equipped, to solve them? Very poorly so, certainly, and that, we would repeat, is the most powerful deterrent to the development of automation and its auto-regulation. Just as in a firm wishing to become automated, the products which it manufactures must be redesigned, the success of automation in society as a whole depends upon a redesigning of the organization of businesses, institutions and social life in general. The old type of adjustment which we have witnessed hitherto seems increasingly out of date, and we shall find

ourselves obliged, to an ever greater extent, to resort to more conscious forms of social control. Automation itself, by enabling us to effect statistical computations and providing us with increasingly accurate forecasting machinery, practically meets one of the needs which it creates. In the final count, however, the core of the problem seems to us to be the possibility of conscious co-operation among the various social groups in preparing the measures essential for their adjustment to progress.

THE STRUCTURE OF EMPLOYMENT AND AUTOMATION

P. NAVILLE

Is the structure of employment destined to be changed by automation and, if so, in what way?[1]

Before replying to this question, I must define the term 'structure of employment' as it is to be used here.

I shall not speak of employment in the purely economic sense (that is, the volume and qualitative composition of the population engaged in any form of activity from which it derives some sort of profit or remuneration, and the proportions of the different categories involved). From this general point of view, automation can be only a factor of restricted importance, among many others which are more decisive, affecting fluctuations in employment.

I shall therefore take into consideration only such employment as is directly affected by automation, that is, all types of wage earners who are immediately connected with automated industries. Therefore the structure of employment here means the structure of the staff employed at any level in industries which have been, or are in the process of being automated.

To simplify the problem still further, I shall deal only with that part of the working population which consists of wage earners in industry and transport, since it was in these fields that automation first made its appearance and it is therefore here that we can try to discover some of its effects on the manpower employed, while noting, of course, that the concept of 'manpower' is here losing more and more of its original meaning. In the interests of accuracy, the armed forces should be included in this fraction of the working population, since the increasing needs of armies, navies and air forces since the second world war have given considerable impetus to automation, just as the demand for traditional-type machine-tools grew rapidly as a result of armament requirements during the years 1914-18.

Before the actual subject of this report is broached, however, a few words

1. I need not repeat a definition of automation here. It is enough to say that automation, in the most general meaning of the term, concerns the auto-regulation of a programmed production an/dor information cycle. Any production or service cycle can be automated in varying degrees at different points. As J. Bright and R. Teani have shown, it is possible to measure the average degree of automation of a cycle.

should be said about general conditions of employment in relation to the present state of progress in automation.

The development of automation has been speeded up within the past ten years in an economic context of practically full employment and even, according to certain economists, of over-employment, that is, permanent and excessive scarcity of certain categories of worker. It was therefore inevitable that recent technological changes should reveal problems not raised by the first industrial revolution which was brought about by the use of the steam engine and then of electricity in the nineteenth century.

At that time, industry was able to draw freely on an ample reserve of manpower supplied by rural areas or towns, and to thrust back the surplus into that reserve in times of crisis. This was perhaps one of the reasons for the slow progress of automation at that time, despite the fact that its general principles had already been grasped by Babbage and that it had been fully applied in certain devices, such as the Evans' Mill, as early as the middle of the nineteenth century.

Furthermore, automation has been introduced during a period of population growth, which in itself constantly increases the supply of manpower. And lastly, it may be noted that automation is developing on similar lines both in countries with a capitalist economy and in those with a system of state socialism—the only form of socialism which we have experienced so far, but which did not exist in the nineteenth century.

These general conditions are enough to show that automation is developing, in the contemporary world, in a very different atmosphere from that which obtained during the period of mechanization which lasted from 1860 to 1914. They also give some indication as to the way in which automation may influence the structure of manpower. More than that—they already enable us to raise this preliminary question: Is not automation itself the outcome of certain new conditions governing employment and the structure of employment, rather than their cause?

Generally speaking, investigation of the particular phenomena occurring in firms where automation is being introduced shows that employment and the new technique exercise a *reciprocal* influence, which has always existed, but is today assuming forms that deserve study and that vary considerably from one field to another. It will suffice to recall the following sequence: (a) the automation of a given production cycle releases a certain volume of employment; (b) the resulting increase in productivity and the subsequent extension of needs and means of consumption and capital accumulation open up new possibilities of employment. An increase in the total volume of employment and movements of workers would thus occur simultaneously.

It is obvious that if this trend is confirmed (as the planning services of the Union of Soviet Socialist Republics believe it will be, and as Western economists daily assert—although they appear less firmly convinced), the following change in the relations between employment and automation will be noted: the level and forms of employment (linked with investment) will affect the tempo of automation, while at the same time the latter will necessitate changes in the structure, and perhaps also in the level, of employment. Automation should here be taken as the symbol of all recent technological progress, since in it are concentrated the most advanced forms of such progress, just as individual machine tools and engines represented technological progress

in the preceding period, without however covering the whole field of industrial, commercial, agricultural and administrative activity.

If the problem is viewed as a whole, therefore, automation should not be considered merely as a factor having certain effects on manpower, but also as being itself partly the result of certain employment movements. However, the two phenomena do not appear at the same levels, or in the same forms, or at the same time. The automation of a firm may depend on the manpower which it employs or could find on the labour market and on the salaries which it pays, and at the same time automation creates new jobs, which may be given to old or new employees.

When reference is made to labour released by automation (for example, the number of employees transferred or dismissed as a result of the introduction of computers in offices), and to the tempo of automation resulting from the general labour situation, the form of labour in question in either case is not the same. It is impossible to apply the same arguments to both, since their dynamics are different.

As a general rule, the whole employment situation depends on investment and on the market. But investment (itself depending upon the conditions in which capital is accumulated) influences employment in two different ways, since its immediate effect in the firm concerned may be a reduction of employment, although it may, at the same time, lead to an increase in employment in the economy as a whole by causing new branches of industry to be created and by promoting the production of means of production. An illustration of this last point is provided by the introduction of automation, which requires large and long-term investments for research and studies and the designing and construction of automatic equipment.

These problems inevitably have to be considered, if the exact meaning of the following statement, repeated by conference after conference, is investigated: Automation will 'affect' only about 8 per cent, or from 6 to 10 per cent, of industry and therefore of the manpower employed therein.

What does 'affect' mean here? Does it mean an 8 per cent reduction in employment as a whole, or employment in the branches of industry concerned? Does it mean the transfer of 8 per cent of the manpower from one branch of industry to another? If, however, relative reductions of manpower have as a corollary a total increase of the volume of employment, what does this estimate of 8 per cent mean? And if the total volume of employment goes down and a considerable amount of unemployment exists at the end of a moderate length of time (say, one to two years), is not the percentage of workers 'affected' higher than 8 per cent? Further, it is not only the total number of workers that may be changed, but also the cost and the qualitative composition of manpower, and the nature of the division into categories of workers and operations. Such an estimate does not therefore appear to have much meaning.

The total volume of employment is not determined solely by the technical nature of production operations, but also by certain far more general economic conditions. Technological changes first affect the relative distribution of the different categories of workers in the sector where such changes occur: This effect, however, does not necessarily assume a quantitative form, i.e., a change in the volume of employment. A firm may alter its equipment considerably, and consequently the duties of its employees, but this does not mean that the total number of its staff increases or diminishes to any great extent.

The case of firms entirely organized round an automated technique should

also be considered separately, since automation naturally coincides here with a greater or lesser demand for staff. The most common case is, moreover, progressive automation, by sections, of a production cycle already to some extent mechanized and automated. It is then extremely difficult to define the relative importance of changes due to automation in internal employment and in the other sectors of the business. The increase or decrease of supervisory, management and administrative staff is not necessarily directly related to the introduction of automatic devices.

Before we attempt to discover what effects automation will have on the structure of manpower, another preliminary question might therefore be considered: Is it possible to distinguish the immediate effects of automation from the more or less direct effects on the whole of the firm in which automation is being introduced? A direct effect is certainly visible when a group of isolated machines producing a given part and operated by n workmen is replaced by a smaller group of transfer machines operated by only $n/3$ workmen. However, these transfer machines themselves represent only one element of the whole production cycle. Yet the automation of any element of the cycle to some extent affects the whole cycle; it therefore has effects on the staff employed throughout the cycle. How far do these effects extend? May they not even have repercussions from one firm to another?

Certain automated machines, for example, require the fluid or solid materials to be processed to have certain given physico-chemical characteristics, and such materials are nearly always supplied by another firm. The frames, tools, pipes and the apparatus for transfer, measurement and checking are also usually produced elsewhere than in the concern which uses them, in accordance with standards determined by the characteristics of the automatic handling plant, but are not themselves mass produced automatically; employment in the firm which manufactures them will therefore nevertheless be indirectly affected by automation.

Thus, step by step, automation may have certain long-distance effects, in both space and time. Conversely, it is indirectly affected by certain general conditions of employment. In order to understand these effects more or less clearly, however, a great many data would be necessary which are inaccessible to us for the time being.

We have only to recall, in this connexion, the discussions which took place as a result of the dismissal of workers by the Standard Company in England in the spring of 1956, at a time when that company was installing automated equipment for its production of tractors at Coventry. According to a report drawn up by Mr. G. A. Cass, it appears that out of the 2,759 workmen dismissed, some 600 lost their jobs as a result of the automation of production, whereas the others had to leave on account of the crisis in the market, resulting in a reduction of employment. Of the 1,300 men already dismissed by 7 June, some 700 had found other work quite quickly. In this case, two apparently independent series of causes therefore seemed to be intermingled. However, there was probably a connexion between the two events; the decision to devote investments to the partial automation of the business may very well have been made at a time when a certain contraction of the market obliged the company to cut down its labour costs.

Another example, in different circumstances, is provided by the Renault factory, which proceeded in 1945 with the planning and installation of transfer machines because of the shortage of the usual skilled workers (who were still

mobilized or in Germany). In the United States of America, many firms have clearly stated that it was the high level of wages, despite the abundance of manpower, which originally made them decide to speed up automation.

It is therefore obvious that, in order fully to understand the relations between automation and the structure of employment, we must look far beyond the questions raised by the immediate relations between men and machinery. Nevertheless, the description of structural changes directly caused by automation at the level of the individual operator, work teams and individual firms is quite interesting enough to merit a little thought. Such changes are, moreover, recent and the process, which is by no means over, has hitherto been very little studied on its own merits. The information which follows is therefore limited and subject to revision.

I can at once, however, formulate two general conclusions which seem already to have been confirmed by known facts in the more restricted field with which we are now dealing:

1. The changes brought about by automation do not so much concern the relations between workman and machine as those between workman and 'workshop'. (The sense in which the term 'workshop' is to be understood will be explained below.)
2. These changes seem in fact to accentuate a trend which has been apparent for some time with regard to the apportionment of work to be performed, the grouping of workers, output and remuneration. (They are however sufficiently important to have, in their turn, specific effects on the relations between the different categories of industrial personnel, their employment and training.)

These changes will be classified in four groups, which so far have not all been studied to the same extent: (a) quantitative changes; (b) structural changes; (c) changes in value; and (d) changes in behaviour. These four types of change, of course, overlap and are separated here for the convenience of analysis only. They nevertheless correspond to a certain gradation which can be seen in their effects.

The most immediate are structural changes: nature of working stations and operations, form of teams and work sequences and type of training. Then come quantitative changes, i.e., volume and density of staff per production unit. Then changes in value, i.e., measurement of output and wages. Lastly come changes in behaviour: kinds of qualities required or engendered, individual and group reactions and attitudes and alterations in the forms of spontaneous groupings and associations.

This systematic classification may appear somewhat arbitrary or far-fetched, yet it seems to be the natural outcome of a series of observations, some of which merit mention here.

QUANTITATIVE CHANGES

Everything depends on the size of the production unit in which the changes are measured. If only the machines, groups of machines or instruments which are actually changed or added are taken into account, considerable alterations and transfers can be observed which may affect practically the whole of the former staff.

However, despite the extremely precise nature of certain oft-quoted

examples, no general conclusions can be drawn therefrom without searching criticism. The following are a few of these examples, drawn from the United States of America. At the Cincinnati Milling Machine Company in 1949, 6 machines produced 108 parts per hour, for a labour cost of 20 cents per part. In 1954, one automatic machine produced these 108 parts for a labour cost of 4 cents, i.e., one-fifth of the working time. At the Cross Company, 5 machines were replaced in 1952 by a single transfer machine; 3 men turned 10 parts an hour on the old machines and 2 men were enough to produce 24 parts an hour on the new one. Another company employed 38 workmen and 29 machines to drill a series of 18 holes in a crank pin; in 1953, the same number of holes were drilled by 9 workmen and 3 machines.

A machine at the Hautau Engineering Company turns aluminium parts at the rate of 2,000 an hour; one part-time operator is enough to ensure this production, which previously occupied 55 men. Thomas Industries Incorporated produces and assembles with 9 automatic machines the same number of grenades as with 27 machines of the old type, and employs 9 unskilled operators instead of 27 skilled workmen.

Similar examples have often been quoted, again, for the most part, from sources in the U.S.A. Here are a few more: cylinder heads (General Motors), formerly machined by 17 men, are now produced by one man. Cylinder blocks are mounted by 25 men instead of 117. The cylinder blocks themselves are machined by 57 operators instead of 1,500 (at the Heller Works in Germany, only 6 operators are now required instead of 36, for the same operation).

The same reduction is to be observed in quite another field: the automated thermal electric power station at Nantes-Cheviré (France) has each of its three units operated by 7 men (the first unit formerly consisted of 2 engines, 2 boilers and 85 men; the second consisted of 1 engine, 2 boilers and 35 men; and the third, the most recent, consisted of 1 engine, 1 boiler and 25 men). In the end, there will be one employee for 2,250 kW., whereas the French National Electricity Company still has to have an average of three employees for 1,000 kW.

A moderately automated oil refinery with a staff of 800 men can, after very advanced automation, operate with 12 men, while the most up-to-date refinery units can be operated by shifts of from 6 to 8 men.

All these figures, which concern movements of manpower resulting from the installation of integrated machines or continuous processes, show staff reductions of about 80 to 95 per cent. This is, of course, a high proportion and if these figures were indicative of a general trend, they would point to extensive dismissals and reclassifications which would be difficult to control.

Other cases have been cited where the proportion of replacements has been less high; from an analysis of published case material, G. A. Cass noted that, on an average, 77 per cent of direct labour had been rendered superfluous. On the basis of 12 cases, a Chicago research worker estimated this average at 63.4 per cent, including indirect labour. Other examples show staff reductions of from 10 to 30 per cent.

The disparity between these figures shows either that there is no valid criterion for comparing them, or that manpower replacement conditions vary enormously from firm to firm. Both conclusions are probably justified. However, criteria for formulating such conclusions must be defined and this calls for far more complete data than those at present at our disposal.

First, it should be noted that all the figures for staff reductions due to

automation relate to very ill-defined production cycles. Sometimes they relate to direct operators—who are needed immediately to supervise or work certain machines. At other times, maintenance workers are also counted. In the majority of cases, it is not explained where the automated cycle, for which the staff has been reduced, begins or ends.

Reduction figures are therefore difficult to compare, since they are included in whole production systems for which complete statistics are not available. Transfer machines use less direct manpower than the machine tools which formerly carried out the same operations; but these machines, and the staff who work them, are themselves directly dependent on production units which are sometimes more numerous after automation than before it. For example, the automatic process of the Chantereine glass works is controlled by about 10 workmen, but the whole factory has a staff of 1,700. The Renault Company has only about 1,000 employees working in the automated sections of the production cycle, but the total staff, in the factories concerned, numbers some 45,000 persons.

In the case of far bigger concerns, such as the SNCF (French National Railway Company) or the EDF (French National Electricity Company), the total number of employees has declined sharply in the past 10 years of accelerated modernization. But what part does automation, as such, play in this modernization process and in the attendant reduction of employment? Since 1950, the staff of the EDF has dropped by 8 per cent and that of the SNCF by 20 per cent, whilst productivity has increased considerably. In this case (power production and transport), it is not the market which has shrunk—quite the contrary. Automation has not upset the general structure of these industries. It is therefore probable that the relative reduction of employment here is due only in very small measure to automation.

It is necessary at this point to go more closely into the idea of replacement (or movement) of manpower caused by the introduction of new machines, groups of machines or continuous working equipment. In fact, the numbers of workers before and after the installation of the new equipment are seldom comparable, because changes in the number are mainly due to a change in the quality. To say that 100 employees used to work directly on the production of cylinder blocks and that 20 or 30 are similarly employed after the introduction of transfer machines, is an arithmetical statement of little significance and one which is to some extent misleading. In fact, it is not a question of men replacing men, but of a metamorphosis of individual or group work. The actual jobs are not precisely the same afterwards as they were before. It is quite conceivable that the introduction of automatic equipment might not change the total number of employees in a given production unit, although it would completely change the qualifications required, the nature of the operations and the structure of the shifts. A constant total—or unchanged volume of employment—may be accompanied by a complete reclassification of the personnel. The same number of people will be employed, but they will not be the same people.

It appears that this is often the situation. The example has been quoted of a chemical products factory in Great Britain where, with a constant total of 1,000 employees, the number of production workers was reduced from 700 to 550 after automation, while maintenance staff increased from 300 to 450. Employment remains stable and does not raise any quantitative problems, but the difference of qualitative composition raises a great many. Apparently

that is why the problem of internal transfers is so acute in large firms. It is almost as difficult in a unit like the Renault Works at Billancourt to transfer workers from the Ile Seguin to other departments as it is to move them to Flins or even to dismiss them.

There is, however, a borderline case which should also be studied, namely that of a production unit where employment has gone to a level which cannot be further reduced, and where what might be considered as the best possible technical level of employment has therefore been reached. Certain hydro-electric plants and oil refineries seem to be drawing near to this point. The cost of wages then becomes absolutely steady; the number of operators, where the proportion of maintenance workers or technicians grows, cannot fall below the minimum compatible with the running and maintenance of the production apparatus. The cost of labour then becomes assimilated to overheads; it may possibly increase, but can no longer decrease. This is one of the most interesting trends with regard to the possible effects of automation on the quantitative aspects of employment.

Such examples, however, are few and far betwen and are not likely to become the general rule for some time to come. For the time being, the plainest data on quantitative changes resulting from the introduction of automatic devices therefore seem to bear on the relative variations of the different categories of employment, which leads us to the question of structural changes.

STRUCTURAL CHANGES

The changes in employment which I shall here treat as specifically structural changes concern the nature and type of work required of workmen, supervisors and technicians of all kinds. These are not changes on which economists have concentrated hitherto, since they have been more concerned with the volume of employment and its cost. On the other hand, such changes are quite familiar to the general public, to whom automation is becoming practically synonymous with *farniente* and 'push-button' work. This imagery has been widely exploited, even in the Union of Soviet Socialist Republics, where the reporter, Erivansky, tells us, for instance, that, at the automatic piston factory in Moscow, it is very difficult to say whether the two workmen who are responsible for the supervision and maintenance of the machines 'are workmen or intellectuals'. Of one of them he says: 'His working hours are entirely at his own disposal. He can talk and joke as much as he likes; he even has time to read. You see, he has a book tucked under his arm!"

But, joking aside, very little research on changes in operations has been done as yet and the process of change itself is by no means completed. All I can do, therefore, is to show what such changes mean by giving a few examples.

Certain reliable observers consider that the principal groups of activities and qualifications created are the following: first, there are those who work and supervise complex machines; then there are those in charge of signals and controls; and then there are the computer operators. Certain jobs, moreover, combine several of these characteristics, for example, when a programme machine carries out its work under the eyes of the watchful supervisor at the signals and controls switchboard.

It will be seen that these distinctions apply mainly to workers directly associated with the operation being carried out, if only for the purpose of

supervising it. But these operators are by no means supervisors alone. Only a very few jobs, particularly in certain continuous process industries, amount to pure supervision (e.g. control panel duties). On a transfer line, direct work is combined with inspection and maintenance, just as, with the old machine-tools, feeding was combined with regulation. The same operations recur on automated lines, but in different forms, at different rates and with a different distribution of work. The employee who loads, unloads and starts a transfer machine carries out practically the same operations as the skilled workman on machine-tools. The maintenance foreman is also a tool-maker and adjuster, but of a new kind. There is no real difference between the operation of an individual automatic machine-tool, that of a copying or programme machine, and that of a transfer line. The operator's tasks are graded in accordance with a similar scale, ranging from the skilled workman to the professional operator and foreman, with more frequent intervention of maintenance staff or operation and production engineers. What changes is the tempo of work, which is regulated far more closely by the programme of the machines—although this does not necessarily mean that it is always slower—and the kind of physical efforts that have to be made.

It is on the maintenance side of the work that the greatest number of new jobs are becoming available. Maintenance is combined with the control of operation and rapid repairs and calls for more flexible and varied abilities. Because of its growing importance, it is coming to be regarded more and more as a part of direct production work. The proportional increase of maintenance work is the most striking feature of the structure of automated concerns.

The jobs which appear to be the newest are those in the second class, i.e., controllers of signal switchboards. Here again, however, the question is rather one of the more general introduction of jobs of a type already long established in electric power and transformer stations, the chemical industry, railways, etc. They are to be found, on a restricted scale, in connexion with complex machine-tools and, on a very extensive scale, in the control rooms of oil refineries, or of certain large integrated engineering systems such as the transfer chains of the Chrysler factories. These operations may range from supervision of control boards one yard wide to that of panels dozens of yards in width. The supervisor is then completely separated from the production machinery and controls its operation only through the medium of a 'language' which he has to interpret. Such operations carry heavy responsibilities and require above all considerable powers of concentration and interpretation. They are, however, very few in number. The same can be said of the jobs of operators and controllers of computing machines.

It is therefore in the team, or group of workers, that the most novel structural changes due to automation occur. This is because the new integration of a complex mechanized system must be matched by a new integration of the men employed in this system. This is what I have called the 'workshop' revolution.

Moreover, in this field also, the most diverse industries are being brought to follow the example of industries which were formerly less advanced but which were obliged to provide for specially composed teams in order to carry out slow, combined operations.

The introduction of individual machine-tools for the production of separate parts broke up the old workshop. Teams had hardly any specific structure any more; they were formed by the addition or juxtaposition of individual oper-

ators, each of whom made a certain part or did some work on a part. Hence the importance of the foreman and the head of the workshop, who had to co-ordinate the work by adjusting the various tasks, and the vital function fulfilled by stocks, which allowed for adjustment in terms of time.

Even the assembly line teams amounted to hardly more than a cumulative series of piece-work operations, carried out on a conveyor-belt instead of at a fixed station.

In workshops not engaged in mass production, where the nature of the articles produced meant that a series of continuous operations had to be combined, as in iron-smelting, chemical industries, coal mining or building, the structured team retained its predominant role; it was a group of specialists co-operating on the same task. This type of team had been eliminated as a result of the 'parcelling out' of work and the very considerable shortening of the production cycle, characterized by accelerated repetition. Today, however, with the advent of integrated automatic systems, it has reappeared (just as the combat team or task force is taking the place of the old battalions), but in a different form, of course, direct manual work on the material concerned being far less common.

Nevertheless, the structure of the new teams using automatic devices is comparable with that of the former type of team, rather than with that of the pseudo-teams of individual machine or assembly line workshops. This comparison also holds good in regard to the duration of work, since continuous operations make it necessary to adopt the system of three shifts of eight hours each, or even four shifts of eight hours, in the most modern oil refineries and also in blast-furnaces or rolling-mills. In the final count, such plants should work 24 hours out of 24, whereas the machine-tool shop could work one or two hours a day, or at a lower rate of output, where necessary.

What, for example, was (and, in point of fact, still is) the old type of heavy forge team? It was a coherent group consisting of a foreman to direct and control the operations; a hammersmith and his assistant, who were skilled workmen capable of doing any job with a power-hammer or forging-press; a temperer and a stoker, responsible respectively for the thermal treatment of the metal and the furnaces; a hammerer or presser; an overhead crane-driver and assistants or carriers. The hammersmith is the hub of the team's work, every phase of which must be co-ordinated. Here, integration of work is primarily a matter of integration of men.

Now, with the introduction of self-regulated, long-cycle automatic devices, it is no longer the men but the machines which have to be integrated. However, such a highly organized structure in its turn necessitates a team structure, this time of a different kind.

When transfer machines were first introduced into the Renault factory about 1955, what was the engine-block production team like? It consisted of 120 production and handling workers, 15 regulators for 30 machines (including 9 transfer machines), 6 temporary maintenance workers and 3 temporary electricians. The 120 production workers formed the permanent core of the team, employees responsible for maintenance and electrical equipment being only temporary. Following the reorganization in 1956, the team acquired a permanent structure of a rather different type, each form of employment being closely linked with all the others. The team now consists of: approximately 20 production and handling workers, 12 regulators for 19 machines (including 16 transfer machines), 12 permanent maintenance workers and

6 permanent electricians. The team has thus changed in structure and become more rigid and homogeneous. The working stations are less important, considered separately, but far more important on account of their interdependence.

This points to the conclusion that, where automation is introduced, the principal changes in working conditions do not so much concern the individual worker's relations with the machine, as the relations between groups of workers and groups of machines. This transformation obviously implies a change in the relationship between operator and apparatus, but that change has its full significance only within the context of the group's new integration.

With regard to changes affecting such individual operations as still subsist, detailed analyses would be necessary in order to understand more fully how they are integrated in a team's work. The differences are very great from one industry to another.

There has been rather too much haste to introduce the term 'collective qualification' in this connexion. The integration of stations of course results in a greater measure of 'shared' responsibility than when each operator can proceed with his work more or less independently of the others. Nevertheless, this link does not seem to imply that individual differences in abilities and qualifications disappear, even in the case of 'supervisory' operations. Maintenance jobs also tend to show considerable diversity.

It would therefore be desirable (when working stations of this type have become more or less stabilized) to study the form of the links between working stations and the structure of the network which the latter constitute. The area covered by such networks may be considerable—sometimes hundreds of yards in length—to such a point that one of the dangers lies in failing to maintain the links. But these are almost special cases, since each structure has been created to meet specific needs. The important thing here is the 'node' of the network, in other words, the point where human intervention starts, where the workman may have to move about, as, formerly, in the operation and supervision of many looms in the textile trade.

On a continuous glass production line, two workmen may be stationed at some distance from one another: one of them keeps a continuous watch on the degree of fusion of the glass in the train, whilst the other awaits signals (intermittent supervision) indicating inequalities of tension in the sheet; their jobs, although different, are connected and included in the same supervisory category. On the same line, a workman inspects the cooled-off sheet and informs his colleague, some ten yards further along, of any defects which he has discovered in it. Thus, their jobs differ, but are interdependent. It is precisely this that characterizes their work and the integration, dictated by the machinery, of their jobs.

CHANGES IN THE VALUE OF WORK

What changes does automation bring about in forms of remuneration? This is a question deserving thorough study; it is very difficult, however, to conduct such a study in the absence of statistics, which the various firms are slow to supply; these alone would make it possible to form general conclusions.

Here again, there seems to have been rather too hasty an assumption that remuneration on the basis of output has disappeared. Automated work cannot, of course, be remunerated 'by the part' and it is impossible to do overtime

during rush periods or when the foremen decide that it is necessary; but such remuneration started to disappear long ago in conveyor-belt production and, in general, is disappearing wherever teamwork predominates.

Work measured by individual output therefore tends to be replaced by new forms of work measured by collective output. Output bonuses can then be calculated on the basis of productivity, either for each workshop or for the firm as a whole. I know a paper factory where a 'factory bonus' based on productivity has taken the place of several of the old output bonuses.

It appears, moreover, that the tendency to merge individual outputs in the total output, which is inherent in the operation of integrated machines, comes up against obstacles due to changes in the qualifications required of the new operators. For although the output of each individual can no longer be related to his own work (since such output is entirely conditioned by the machine's programme), the various operators nevertheless fulfil different functions, calling for different qualities. One of the most sought-after qualities is a sense of responsibility, all the more necessary on account of the considerable value of the equipment used and the seriousness of the possible consequences of any interruptions in the production process. At the individual level, therefore, new kinds of bonuses tend to appear, particularly 'responsibility' bonuses, which are finally reflected in differences in wages.

Changes in the structure of employment are therefore inclined to react on the wage structure, independently of fluctuations due to the state of the labour market, particularly for certain categories of highly skilled staff. The respective values of the different levels in the scale of qualifications are therefore going to be altered in somewhat unexpected ways and this question will certainly come in for close examination in forthcoming collective bargaining negotiations.

It is therefore doubtful whether changes in the wage structure due to automation will be concomitant with the disappearance of the concept of output. It is more likely that this concept will be transformed and will take on a more collective character; greater importance will be attached to responsibility, and the tendency will be to define individual abilities in the light of new qualitative categories of employment. Investigations have already been undertaken in certain factories, particularly with a view to introducing the idea of output in maintenance work.

CHANGES IN BEHAVIOUR

Socially and psychologically, the most important effect of automation on employment relates to the behaviour of the staff employed. At the present time, information on this subject is practically non-existent, or so contradictory and superficial that it can scarcely be used in a serious analysis.

As the various earlier stages in the history of industry show, it will be impossible to gain any real understanding of the new attitudes and forms of behaviour engendered by the manipulation and control of automated production units until specific conflicts or difficulties have arisen. For the time being, the only reactions to be observed are those of fear, in varying degrees, caused by the possible insecurity of employment, wage variations, problems of adjustment to new and unaccustomed jobs, and requirements in the matter of vocational training.

A certain amount of scepticism—largely justified hitherto—has also been noted in regard to the increased 'leisure' which has been promised in various quarters, and the ease and pleasantness of 'push-button' work.

With regard to leisure—here signifying the part of the day or night not given up to work—the problem can hardly arise until the working day and the working week have been considerably shortened.

For the time being, the average working week in France is roughly 45 hours, and the reduction of certain working hours and overtime is due to market difficulties, rather than to automation. Even in cases where two, three or four daily shifts are the general rule, the working day is always eight hours. Since shorter hours of work are accompanied by a reduction of actual weekly take-home pay, workers are anxious, not so much for more 'leisure', as for additional earnings, and therefore overtime.

It is possible that pressure by workers' organizations and the need to avoid widespread unemployment will later lead to a shortening of the working week, to 40 or 36 hours, compatible with the technical requirements of automated machinery, and spread over five days. In that case, the whole system of shifts would undergo considerable changes. Five eight-hour days make up the 40 hours but, for a 32-hour week spread over five days—a system already considered by certain American trade unions—shifts would have to be reduced to a little over six hours, i.e., in order to keep the machinery in continuous operation, there would have to be more than four shifts a day. It is easy to imagine what major problems such a reorganization would raise and how necessary it would be to tackle them in close co-operation with workers' organizations.

For the time being, therefore, the real problem does not seem to be so much that of 'leisure' as that of the internal adjustment of working hours. It is noticeable that pauses are more frequent in certain jobs in an automated cycle. Some may be quite long, for example, in maintenance work or in the supervision of signal switchboards. However, such jobs are still fairly few. In any case, where long intervals occur it would appear desirable for them to be devoted not to 'leisure' but to related activities, such as further training lectures, discussion meetings, or full-scale courses, which would enable the various teams to extend their co-operation in new directions and, at the same time, to engage in activities useful to production. Such arrangements would probably, incidentally, raise somewhat difficult problems from the point of view of the relations between the different categories of workers.

It has already been pointed out that the psychological and physical strain imposed by supervisory jobs may result in a certain kind of boredom, due alike to the discontinuity of the work and relatively long intervals between the periods of activity, and to the semi-solitude of the control rooms. Such effects, incidentally, are not peculiar to the world of industry: they are also felt by aeroplane pilots and engine drivers. Yet, in industry, there seem to be rather contrasting effects in this respect, since there is also the strain on powers of concentration, due, in some cases, to the large size of the switchboards to be supervised and, in others, to the nature of the (auditory) signals.

Speaking more generally, the great defect of automated systems is, as J. Rosenberg has pointed out, that they more or less destroy curiosity. And curiosity, involving anticipation and imagination, is the mainspring of concentration. Without it, the operator's spirits, deprived of stimulus, sink to a low ebb. From this point of view, the operator's remoteness from the object

of his work, and its intermittent nature, produce effects similar to those resulting from the constant repetition of the same unvarying movements—the operator falls a prey to monotony and his curiosity dies.

However, this new danger appears to affect only a few rather special supervisory jobs. Operators in direct contact with transfer machines still have to keep up a swift tempo of work, even in simple gestures such as loading or unloading the part to be machined.

There again, the destruction of that curiosity which is so essential to interest in any job is merely carrying on a trend inherent in all mechanization. When a man ceases to carry out a task himself, he also ceases, to a large extent, to take any interest in it, because it no longer raises any problems for him. Interest and curiosity are then possible only in certain skilled maintenance jobs and in research bureaux where creative manpower, i.e., research technicians and development engineers, do their work. Is not automation liable to widen still further the existing gulf between interesting and uninteresting jobs? Creative curiosity about things would then become concentrated among the few highly qualified workers, while the general run would be obliged simply to supervise machinery which they did not really understand. There would then be a danger of the work's seriously overshadowing the man.

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AUTOMATION AND INDUSTRIAL RELATIONS

PAUL EINZIG

The impact of automation on industrial relations has been the subject of heated controversy. In particular, the discussion of the effect of automation on employment, on the balance of power between employees and employers, on the standard of living of the workers and on wage differentials, discloses sharp divergences of opinion. The trade unionist point of view, expressed by innumerable resolutions, is that automation constitutes a grave danger to the security and welfare of employees in general and of unskilled labour and office workers in particular. Spokesmen of employers, on the other hand, seek to minimize the importance of automation. As a reaction to the exaggerated pessimism of the trade unions, they fall into the other extreme by taking the line that automation has created no new situation and has given rise to no new problems. This view is endorsed by most economists who have taken notice of automation.

The attitude of both sides of industry, and also of some 'neutral' quarters, would seem to depend largely on the view taken of the probable maximum limits of automation and of the pace at which it is likely to progress. Trade unions take an alarmist view because they foresee a spectacular progress of automation resulting in large-scale redundancy, a weakening of the bargaining power of organized labour, widespread individual hardship, and a general decline in the standard of living of the working classes. Employers and economists who do not expect any drastic economic changes to arise from automation base their view on the assumption that its progress is bound to be

slow and that, taking industry as a whole, it cannot proceed very far. The extent of the possible and probable progress of automation and the rate of this progress is of course largely a matter of opinion. There is sharp disagreement among technologists about the prospects from a technological point of view, apart altogether from the uncertainties of the economic aspects of the matter. In the circumstances, it seems advisable to reserve judgement about the prospects and to confine our analysis to factual material obtained from actual experience. Although automation did not become an economic problem until after the war, even this brief period offers some valuable lessons.

One of the lessons taught by post-war experience is that the effect of automation from the point of view of industrial relations, as indeed from various other points of view, depends not so much on the rate of its progress as on the economic background against which its progress takes place. Automation is liable to produce totally different effects on conditions of employment according to whether it is adopted in an atmosphere of boom or in an atmosphere of business recession. Although the rate of its progress is by no means a matter of indifference, expanding economy seems capable of absorbing a high degree of automation without any adverse effect. If automatic labour-saving equipment is installed in a contracting economy, the same extent of automation is liable to be extremely detrimental to employment.

Had automation developed during the 1930s it would have been accompanied by an accentuation of unemployment, which would have aggravated further the prevailing depression. Under bad trade conditions automatic equipment is installed primarily for the purpose of saving labour and thereby cutting down the cost per unit. Employees who become redundant through automation are dismissed as a matter of course. Under conditions of full employment, such as those prevailing during the greater part of the post-war period, the main object of automation is to enable industrial firms to increase their output. Although they are naturally anxious to reduce their costs, it is more important for them to overcome the limitations imposed on their output by scarcity of labour. In such circumstances automation need not lead to immediate redundancy dismissals.

Although some workers may become redundant as a result of a progress of automation during a boom, they are likely to be retained so long as the expansion of the economy continues. Firms with full order books are anxious to avoid conflicts with their employees, and then may prefer to 'hoard' labour rather than to release workers for the benefit of their rivals.

Automation is also liable to give rise to unemployment by affecting the competitive capacity of less progressive firms which may be undersold by their more progressive rivals. Here, too, everything depends on the economic climate in which automation is applied. During a period of bad trade the progressive firms pass on to the consumer the full benefit of their cuts in costs. They lower their prices. This is necessary in order to maintain and to increase their share in the inadequate and contracting market. As a result, the less progressive firms are forced out of business. However, during a period of expanding economy and rising prices there is much less inducement for the progressive firms to pass on to the consumer the benefit of automation. They are able to sell their increased output at prevailing prices, and for this reason they are tempted to employ the benefit of lower costs for increasing their profit margins. Or they are inclined to take the line of least resistance in face of wage demands, and seek to attract and retain their employees by providing

them with costly amenities. Since progressive firms do not cut their prices, even the less progressive firms are in a position to sell their goods. The difference between automated and non-automated firms is that the latter have to be content with a narrower margin of profit and cannot afford to pay higher wages or spend money on additional amenities for their employees. They may thereby lose part of their staff as many of their employees will be tempted to join automated firms for the sake of higher wages and additional benefits.

So long as automation is progressing in an expanding economy employees in general have no cause to fear its effects on employment and on the standard of living. Pockets of unemployment may, of course, develop in special instances. For example, the large-scale adoption of electronic computers may result in unemployment among office workers. But in an expanding economy they will have little difficulty in securing alternative employment; individual cases of hardship may arise, but their extent will not be sufficient to constitute an important social problem.

Automation is liable to produce a 'delayed-action' effect if the period of boom in which it is adopted gives way to a business recession. Industrial firms, having hoarded their employees who had become redundant as a result of automation, may then be forced to dismiss them. Thus, automation may give rise to unemployment when it progresses in a contracting economy, and also if, having progressed in an expanding economy, the trend becomes reversed. This rule was borne out by practical experience in the British motor industry in 1956. Several motor works carried out extensive automation during the previous year or two without dismissing any workers at the time. When in 1956, as a result of the disinflationary measures adopted by the government, demand for motor cars declined sharply, these firms dismissed a number of workers who had been hoarded and 'feather-bedded' for a year or two.

This experience shows that it is equally incorrect to maintain either that automation necessarily causes unemployment or that it is not likely to have any appreciable effect on employment. The correct answer is that automation need not affect employment so long as the economic background remains expansionary but is liable to cause unemployment when a contracting trend sets in. The extent to which such a turn in the trend may cause unemployment depends also to a considerable extent on the relative progress made by automation. Contrary to the view that is widely held among trade unions, more unemployment is likely to arise in firms which have been lagging behind in the automation race than in firms which have been advancing. While automated firms may dismiss the workers whom they had hoarded, they stand a good chance of retaining a considerable share in the contracting market. Firms which have failed to avail themselves of modern inventions may find themselves hopelessly handicapped by the ability of the progressive firms to cut down their prices. It is well to bear in mind that firms which lag behind in the automation race are only allowed to exist on sufferance, so long as there is not sufficient inducement for the progressive firms to lower their prices.

Automation may give rise to unemployment in certain circumstances not only through redundancy or obsolescence but also through causing bottlenecks. Although at the rate at which it has been proceeding so far the increase in output resulting from it has not been sufficiently pronounced or sufficiently sudden to lead to acute shortages of materials, fuel, or power, the possibilities of such shortages cannot be ruled out. If and when the full benefit of cost reduction through automation should be passed on to the consumer, the

resulting increase in demand for manufactures coupled with the increase in productive capacity may quite conceivably cause not only local shortages but, in certain raw materials, even world-wide shortages. Since the production of raw materials cannot be automated to the same extent as the production of manufactures, the lag between the adjustment of the former to the latter may create bottlenecks. Possibly the bottleneck that threatened to develop in certain types of steel during 1954 and 1955 was to some extent due to the sudden increase in the demand for steel by the motor industry owing to the increase of its capacity through automation.

Such pockets of unemployment due to progress of automation in an expanding economy may merely mean enforced change of employment for most of those involved. In an inflationary atmosphere there should be no difficulty in finding alternative employment. As far as Britain is concerned such is the prevailing degree of employment that even considerable unemployment arising from redundancy or bottlenecks caused by automation could easily be absorbed. It would mean hardship to those concerned, because the chances are that they would have to accept less well-paid employment. But the re-allocation of labour is an essential condition of prosperity; unless the automated industries release a sufficient number of workers to meet the requirements of non-automated industries, the latter will be unable to keep pace with the expanding production. The result may well be dislocation of prices and, conceivably, further bottlenecks.

Moreover, the alternative to allocation of labour through dismissals of workers rendered redundant by automation is re-allocation through the wage spiral. The turnover of labour in Britain during 1955 was very high in spite of the complete absence of redundancy dismissals. Millions of employees changed jobs for the sake of higher pay offered by firms anxious to increase their labour force. One effect of automation is to re-allocate labour without an inflationary wage spiral. Taking a short view, employees naturally prefer to be in a position to pick and choose between rival firms bidding for manpower, rather than to be re-allocated through redundancy dismissal. Taking a long view, however, their basic interests are identical with those of the community. If employees rendered redundant by automation are hoarded during a period of expansion, sooner or later they will have to be dismissed under a contracting economy when it may be difficult for them to find alternative employment.

A prolonged wage spiral eventually does much towards bringing about a state of affairs in which redundancy dismissals must be effected in circumstances least favourable to employees. Progressive inflation is bound sooner or later to force the authorities to revert to drastic disinflationary measures, thereby reversing the trend of the economy. It is questionable whether the drastic disinflationary measures applied in Britain in 1956 would have been necessary had the wage inflation been mitigated by redundancy dismissals as soon as automation made such dismissals possible, rather than deferring dismissals by feather-bedding superfluous workers.

Dismissal of the workers made redundant through automation is the more essential in that the circumstances surrounding automation are themselves liable to create new demand for labour in other directions. It is an open question whether investment in automatic equipment in itself tends by capital expenditure to increase total employment. To the extent to which automation aims at labour-saving this is no doubt the case. To a by no means

inconsiderable extent, however, automation aims at capital-saving, in the sense that the amount of capital employed per unit of output is reduced even if the amount per head of labour employed is increased. The main reason why investment in automatic equipment tends on balance to create employment is that the rate of obsolescence for such equipment is usually very high. Automatic equipment is used very intensively, so that the degree of wear and tear justifies its replacement by more recent inventions at relatively brief intervals.

Another effect of automation is to increase the proportion of those who do not take a direct part in production. This is true of automation of the factory only, automation of the office naturally tends to reduce requirements of clerical labour. Even in this respect, however, evidence was produced before the Joint Congressional Committee on Automation in 1955, indicating that in some instances the number of office workers could be maintained and even increased in spite of the adoption of electronic computers, owing to the expansion of the firm's turnover, and the realization of the need for additional information and other services calling for additional clerical labour.

Moreover, since automation tends to raise the standard of living, it necessarily means the employment of a larger proportion of workers on a wide variety of non-productive services. The post-war trend points towards an increase in the proportion of those employed in service industries. This increase has taken place either in spite of the progress of automation during the same period or precisely because of that progress, through its effect on the standard of living.

Although it is necessary to dismiss labour that has become redundant through automation, this should be done with the least possible friction and the least possible hardship to those concerned. Strikes resulting from redundancy dismissals and from labour's resistance to automation in order to avoid redundancy dismissals, are liable to cancel out a very large proportion of the benefit the community would otherwise derive from automation. For this reason a sensible approach to the problem on the part of employers is essential. The attempt to ignore automation out of existence is not sensible—it inspires distrust among workers and tends to defeat its object. The unions are now fully alive to the importance of automation and they are not likely to be lulled into a feeling of security by being told that it is merely the latest phase in technological progress which has been going on ever since the dawn of civilization. It is doubtful whether a 'conspiracy of silence', had it been practicable from the very outset, would have been able to prevent the development of exaggerated fears of automation among organized labour. Even had it been feasible to induce every newspaper and every politician to treat automation as non-existent, the chances are that trade union officials would have discovered it without any guidance on the part of those responsible for the shaping of public opinion. As it is, the attempt to ignore automation out of existence after it has received wide and exaggerated publicity is foredoomed to failure.

It is a much more practical and a much wiser course to admit the circumstances in which automation is liable to lead to unemployment and take a realistic view about its possible extent. Given a realistic attitude, it should be possible to arrive at an understanding with the trade unions concerning the measures to be taken in order to lessen the adverse effect of automation.

At one extreme there are those who insist that the industrial firms or the community owe full compensation to anyone who suffers hardship as a result

of progress represented by automation. Some trade unions put forward in their resolutions an impressive list of demands for ensuring that no redundant workers should be dismissed, or alternatively that any workers dismissed in such circumstances should receive very substantial compensation. If such demands were to be conceded, in many instances it would effectively prevent automation by making it too costly. At the other extreme are those who shrug an indifferent shoulder in the face of hardship caused by automation and base their attitude on the well-worn proverb that it is impossible to make an omelette without breaking eggs.

The correct attitude lies somewhere half-way between the two extremes. It is absurd to expect the community either to refrain from benefiting by technological progress or to insure fully everyone of its members against any disadvantages that are liable to arise from such progress. There is no justification for slowing down the progress of automation for the sake of avoiding individual hardships. If automation were to proceed on such a scale as to give rise to the danger of mass unemployment, then it would become expedient to take steps to slow down its pace. The possibility of moderate unemployment, however, should not prevent the progress of automation. As the Report of the Congressional Committee on Automation rightly stated however, 'technological change cannot be regarded as progress at all if it is not able to pay its own way, not merely in the junking of old machinery but by giving due recognition to the human costs of retraining and readjustment'.

A summary follows of various ways in which hardship caused by automation could be mitigated:

1. Prevention or mitigation of unemployment by: (a) guaranteed annual employment agreements, (b) feather-bedding practices, (c) reducing working hours.
2. Absorption of the unemployed by: (a) employment-creating government measures, (b) inflationary policies accentuating the general demand for labour, (c) increasing the flexibility of labour.
3. Reducing hardships caused by unemployment or change of employment by: (a) longer notices for dismissals, (b) compensation payments, (c) supplementary relief, (d) priorities at labour exchanges, (3) transference of pension rights, (f) retraining.

Some of the possible remedies are open to grave objections. We saw above that feather-bedding practices adopted to avoid the dismissal of redundant workers during periods of boom are liable to accentuate the boom, and to accentuate the hardships which have to be faced eventually when a subsequent recession forces the employers to dismiss their superfluous workers. Reduction of working hours, at a time when the urgent needs of many millions are still far from satisfied, can hardly be regarded as an ideal solution.

Among the measures to absorb the unemployed, deliberate inflationary policies are open to grave objections unless the extent of unemployment is such as to make inflation appear to be the lesser evil. What is really needed is a reduction of the rigidity of labour. Redundant workers should be willing and able to change occupation and location if in doing so they can step from one employment into another, rather than wait in enforced idleness in the hope of obtaining employment with the same firm or in the same industry.

All the devices listed under the heading of reducing hardship caused by unemployment or change of employment are worth considering. Many firms have admitted the need for giving longer notice of dismissal. Some have

granted a modest compensation to those who have been dismissed. In Britain special steps were taken to increase the efficiency of labour exchanges dealing with large-scale redundancy dismissals. Legislation providing for the transferability of accumulated pension rights is also under consideration in Britain. Most important of all is the device of facilitating the retraining of dismissed workers.

It is of the utmost importance that there should be preliminary consultations between employers and employees concerning the adoption of measures for the mitigation of hardship arising from automation. However, there is no justification for the claim that has been put forward by trade unionists that representatives of labour have the right to be consulted on the basic question whether or not automation should be adopted at all, or even on the rate at which it should be adopted. Human nature being what it is, there is strong temptation for unions to take a narrow and short-sighted view and to veto automation if they are placed in a position to do so. A much more reasonable claim is that, given the need for automation, there should be the utmost co-operation in mitigating the hardships it is liable to entail. Even in the absence of consultations, however, the attitude of the average employer today is quite different to what it was at the time of the industrial revolution. Moreover, in most industrial countries there is today a system of social security which, even if no special arrangements exist, would in itself be capable of preventing hardships comparable to those witnessed a hundred years ago.

Let us now consider the effect of automation on the level of wages and on wage differentials. Automation tends to stimulate wage demands because it increases productivity and profit margins. However, it tends to weaken the bargaining power of many of the most important trade unions by lowering the demand for unskilled labour. Up to now this has not been sufficiently pronounced in any country to cause a decline in the level of wages, or even to arrest their increase. It is, of course, permissible to argue that in the absence of automation the scarcity of labour might have been even more acute and the rise in money wages even steeper, although real wages could not have risen to the same extent without the increase in productivity brought about by automation.

The allocation of the benefits of automation between labour, capital and the consumer is one of the most controversial aspects of a subject which bristles with controversy. The view is widely held even outside trade union circles that labour is entitled to an increase of wages corresponding to the increase of productivity achieved through automation. In Britain responsible ministers have repeatedly asserted that increases in wages are only inflationary in so far as they exceed the increase in productivity. This principle is open to objection on more than one ground. Apart altogether from the effect of its application on the volume of consumer demand, its effect on wage differentials as between various firms in the same industry and as between various industries, is anything but fair. There can be no justification for earmarking the whole benefit of automation for workers who happen to be employed by the firms concerned. The increase of productivity has, in fact, been achieved not by workers but by managements who have to adopt automation—often in the face of opposition on the part of their employees. It would be hardly fair if workers engaged in industries which do not readily lend themselves to automation were to be deprived of the benefit of automation. On the other hand, if the entire benefit of increased productivity were given away to those operating the automated

factories, and if for practical and moral reasons employees outside the industries concerned were also granted higher pay, the additional purchasing power distributed would be well in excess of the additional output resulting from automation. And this would mean inflation.

There is another aspect of this problem. Those who claim that the benefits of automation should be shared out in additional wages overlook the fact that a large proportion of the benefits has, in fact, already been paid out in the form of additional wages to workers who had produced the automatic equipment. Such equipment is not conjured out of thin air, and the capital invested in its production has also to be rewarded.

Provisions have to be made for the depreciation of automatic equipment at a fairly high rate of obsolescence. A fairly substantial profit margin must be allowed so as to encourage investment in automatic equipment, in spite of the risk that it is liable to be rendered obsolete by a new invention. This is also necessary in order to ensure that a sufficient proportion of the proceeds of automation is saved. If all such proceeds were to be paid out in additional wages, obviously savings would be negligible. Higher profits are necessary to ensure higher savings, and without savings investment in new automatic equipment would entail inflation.

The interests of the consumer must also be considered. The only way in which consumers who do not happen to be employees of the automated industries stand to benefit by automation is through a reduction in the prices of the goods concerned. If automation is accompanied by wage demands which are met to an extent corresponding to an increase of the productivity achieved, the consumer stands to gain nothing because there is no margin left for price reductions.

Automation tends to accentuate the conflict of interests between skilled and unskilled labour. In the industries directly affected there will be an increase in the number of jobs requiring advanced training and high intelligence. The scarcity value of such employees is bound to rise unless technical education and training schemes succeed in meeting the increased demand. Unless wage differentials are sufficiently wide there is not enough inducement for young people to take up skilled work involving years of preliminary training. Any additional remuneration earned after years of training may not be considered sufficient inducement except to those who greatly prefer skilled work to routine work.

Throughout the post-war period there has been a tendency towards contraction of wage differentials. The balance of power is strongly in favour of the unions representing unskilled labour. If they succeed in preventing a widening of differentials the progress of automation will be handicapped by lack of skilled labour. The progress of automation is likely to be accompanied by awkward strikes over wage differentials, in the face of which employers are more or less helpless. The only hope of avoiding the waste involved in such strikes would be through the adoption of a wage policy agreed among the various classes of workers.

Frictions are liable to arise also between workers of the same firm when a factory is partly automated, so that some workers have to continue to work in the old section while others are employed in much more satisfactory working conditions in the automated section. This brings us to the effect of automation on working conditions. There can be no doubt that from this point of view automation is an almost unqualified advantage to workers. Apart altogether

from the replacement of man by machine for the performance of dangerous or unhealthy tasks, cleanliness and hygiene can be achieved much more easily in the automated factory. True, the task of watching a board with red and green lights may involve mental fatigue which is comparable to the physical fatigue to which workers in non-automated factories are exposed. Even so, thanks to the labour-saving effect of automation, such dreary tasks can be performed in shorter shifts without undue expense to the management.

The above observations do not aim at giving more than the barest outline of the problems involved. They merely indicate their range and variety and the difficulty and importance of finding solutions to them.

AUTOMATION AS A CHALLENGE TO MANAGEMENT

JOHN DIEBOLD

The machines of the first industrial revolution were introduced into a social order that was not prepared for them. When workers broke their knitting frames and threw cotton printing engines into the river, they were expressing their hostility toward social conditions that offered them no security. Today much of the anxiety surrounding the subject of automation is rooted in the recollection of the first industrial revolution and its impact. Labour is wondering whether automation may not be a cause of unemployment, both in those countries where work is now plentiful and in those which already have a long record of unemployment.

The machines of the age of automation, however, are being introduced into entirely different social climates, and the problems that they pose are different from those of the first revolution. These new machines change the relationship of the worker to the machine, and indeed the very nature of work itself. The problems of automation are staged against the background of a changed and changing society in which both the role of the production worker and the role of the manager are transformed. In this essay, I shall attempt to describe the challenge that automation presents to management now at the beginning of a development every bit as far reaching as the invention of the steam engine. For it must be remembered that automation is much more than a system of machines, fascinating as their performance may be.

It is self-evident that the first responsibility of management is to understand the possibilities of automation—the ways it can be used to organize many different kinds of business operations, in the office and in the plant, into systems, and to control these systems. Managers have often concentrated so much on the machines of automation systems that they have overlooked the essential qualities of this new technology. The result has been that four common stereotyped ideas concerning automation have arisen:

1. That automation is limited to companies with large dollar resources and exceptionally long production runs.

2. That the ultimate in automation is symbolized by an oil refinery or other complex instrument-controlled processing plant.
3. That automation is primarily useful as a labour-saving device.
4. That because automation is highly technical it must be left to the technicians.

The first of these stereotyped ideas—that automation is only practicable for companies with large dollar resources and exceptionally long production runs—is a fallacy resulting perhaps from the idea that Detroit-type automation is the only kind applicable to factory production. It is true that the expensive and very specialized industrial equipment employed in automobile assembly plants, and made for the requirements of a particular product, is not suitable for those industries that produce in lots of 25 or fewer identical pieces. In the United States of America 80 per cent of all industry is such small run industry.

But the new technology of automation that deals with feedback and control systems is producing a new family of machines guided by magnetic or punched paper tape. These machines will make it possible to obtain the benefits of automatic production, and yet to retain the flexibility of operation essential for job-shop production. So far they are only just beginning to appear. Some forty different prototypes can be found today in the shops of machine-tool manufacturers, but during the next few years they will have an enormous impact on the small lot producers of the U.S.A. It is my own conviction that these tape-controlled machine-tools are today undergoing the same evolutionary step that computers were, between their inception in 1946 and their widespread adoption after 1950. I believe that during the next three years we shall witness large-scale production of numerically controlled machines and their emergence as an important part of the new standard equipment in our factories.

Even today, multimillion-dollar transfer machines are not the only kinds of automation equipment suitable for factory use. Managements that consider their production batches too small to warrant the installation of such equipment may well be guilty of what might be called the fallacy of job-shop thinking. For example, my firm was recently asked to suggest automation possibilities for one of the largest manufacturers of shovels in the world. This plant produces hundreds of different kinds of special-purpose shovels in small lots. Each kind, since its shape is unique, was being produced separately. The whole factory was nothing more than a collection of job shops under one roof. Yet analysis showed that about 80 per cent of the company's production could have been made automatic without great difficulty, only no really basic thinking about automation had been done in this particular plant. It was not simply a question of new machines, but one of rearranging the old machines and the old procedures in a more 'systematic' and productive way. Although reorganizing existing equipment may go no further than introducing good principles of materials flow, it is an essential first step in integrating the fabricating operation before linking the individual machines, just as such integration must precede the introduction of over-all automatic control.

The second stereotyped idea—that the ultimate in automation is symbolized by an oil refinery or other complex instrument-controlled processing plant—is recognized as erroneous by those critics who point out that until all the individual, and often highly automated controls in a plant are integrated into a single, co-ordinated, self-regulating system, automation will be incomplete even

in those refineries that are so often pointed out as the most sophisticated examples of automation. Such systems, in which a number of variables are controlled to produce a desired end, are dependent upon the development of an electronic computer capable of analysing, correlating, and correcting the operations of the individual control devices.

There are two reasons why no processing plant is using a computer in this way. In the first place, we do not yet possess a computer that is reliable enough to operate suitably in an 'on-line' capacity for long periods of time, although we are very close to achieving one. A more serious reason is that we simply do not know enough about how process variables affect each other and the end-product. We do not yet have instruments that can measure reliably, accurately, swiftly, and continuously, all the variables of refinery operation, and we do not yet know how to measure, relate, and reduce to equations that a computer can handle, all the process conditions that determine the quality of a given end-product.

Apart from some superficial and over-enthusiastic movements aimed at 'applying the efficiency engineering methods of modern factory production to the work of the office', there has been little real consideration of the plant and the office as essential and fundamental parts of the same whole. However, in the long run, automation is going to change the traditional distinction between plant and office, linking them together as a single, interconnected system.

In the processing plant, such linking of the plant and office will be achieved when each of the regulating instruments can not only automatically correct variations in the variable it measures, but can also provide the management with accounting and production data derived from the process itself, thereby eliminating the costs, the delay, the inevitable error, and the boredom of manual recording, recopying, and eventually keying the information into an office machine for subsequent processing. Once it is possible not only to automatically scan and record variables, but to compute the best manner of adjusting them as well, the feedback loop will be closed, and the entire process can be controlled in terms of changes in the characteristics of the end-product.

Once these technological hurdles are overcome, as they surely will be within the next few years, managements will be in a position to exercise really tight control over processing operations, and to produce increased yields of better products, probably at lower costs. The problems hampering the development of automation here are technical ones.

The third commonly held notion is that automation is primarily useful as a labour-saving device. We are all familiar with photographs of the single operator facing the control panels of a vast petroleum refinery. In fact, so solitary is he that an official of the CIO-AFL recounts the story of a group of such operators bargaining for 'loneliness compensation'. It is remarkable, however, that the profits resulting from the automation of the chemical and petroleum processing industries have not been attributable simply to reduced labour costs, but mainly to the fact that it is now possible for us to control processes too sensitive for human control, and to handle materials whose very production would be impossible without automation. Polyethelene, which in a short time has become almost as common as glass as a container, is a good example. Without automation it simply could not be produced.

In the office where clerical costs have been steadily mounting, it is less

evident that automation should not be introduced with the sole intention of using it as a cost-cutting measure.

Between 1920 and 1950,the number of U.S. factory workers increased by 53 per cent, but the number of office workers increased 150 per cent. Today there are almost twice as many office workers as there were in 1940. One insurance company that installed a computer to handle some of its office procedures had been plagued with recurrent shortages of clerical labour for 15 years. Small wonder that automatic data processing equipment is often looked on as the answer to a management nightmare.

But the trouble with this kind of thinking is that it overlooks the remarkable potentialities of these machines for doing what could not be done at all without them. The payroll, the most common first application used to justify the purchase of a computer, can be handled perfectly adequately by punched card machines; the paychecks come out on time and they are accurate, even though it may take the time of a great many clerks to make this happen. Putting such routine operations on a computer may pay for the computer, but in the end it can never do a great deal more than that.

Executives will never realize the potential of the new equipment if they persist in thinking of automatic data processing in terms of merely eliminating a few or even a good many employees by speeding up old procedures and routines. Mechanization of existing procedures, after all, may merely result in compounding or perpetuating inefficiency. The real aim is not to speed up an old job, but to do a better job. Part of the challenge of automation to management is learning to use new tools to solve new as well as old problems.

The big benefits from automatic data processing will come only when management learns to use automation for its unique ability to provide more complete, more accurate and more timely information about a business.

The thought of more information is a depressing one for the executive who knows that his desk and brief-case are already bulging with information he has not even had time to read, let alone digest. When my firm analysed the operations of a large publishing company, we found that the president received 621 reports during a three-month period, nearly one for every working hour.

But management, if it used the new tools correctly, would soon find that what it has now is not really too much information but rather not enough of the right kind, because the mass of data is too great to be processed by conventional equipment. Automation will enable it to do two kinds of things that it cannot now do at all or can only do in a rudimentary manner.

1. Management will be able to plan in advance on the basis not of guesses and hopes but of facts, because automatic data processing can give realistic answers to 'what would happen if . . .' questions. The management of a big petroleum company with about a dozen refineries in the U.S. periodically had the chance to purchase large quantities of crude oil. Doing so was a complicated affair involving the relating of the particular characteristics of a particular crude to one set of operating characteristics at one refinery. It took months of calculations to come up with a rough 'guesstimate' about the economics of the venture. Often the crude was no longer available once the company had decided to buy it. Or the venture was unprofitable, because the rough estimate had been based on inconclusive facts. The company adventurously decided to turn to data-processing techniques to solve this recurring problem. The entire operation of a

refinery was simulated on a large-scale digital computer. The characteristics of a particular crude were described mathematically to the computer. And about twenty minutes later, a family of solutions had been arrived at, showing the quantities and value of all refined products under different operating conditions at the refinery. Management had for the first time the necessary facts on which to base a sound decision involving millions of dollars. And as a by-product of this simulation, the company was able to analyse the actual operation of the refinery more thoroughly than was ever before possible, and so effected a saving of $1,000 a day in the refinery operation.

This example is only one illustration of the many ways that computers and data processing can assist management in the grave responsibilities of decision making.

2. Management will be able to get quick, complete answers to problems the solutions to which are now incomplete or too late in arriving to be of great use. Recently, a major publishing company was forced to discontinue two of its publications, both widely circulated and historically important magazines. There were many complicated reasons why this action was necessary, but in this particular case the use of automation for decision making might have prevented the disaster. Because of difficult financial conditions, it was envisaged, as an alternative to the discontinuance of the two magazines, that the publication of a third company magazine might be terminated, and its resources thrown behind the other two. It was necessary to determine what proportion of the circulation of this magazine duplicated subscription to either one or both of the two other magazines. Circulation records were kept on punched cards, but they were of such a volume that a cross check of the entire three lists was too expensive. A sample was taken but this, unfortunately proved to be inexact, and the company underestimated the number of cross subscriptions. The result was that the company experienced a severe cash drain that set off a series of chain reactions at a very critical moment. All three magazines were finally discontinued.

   Although such a serious error in decision making need not be fatal in a strong business situation, it was in this case. And this case was precisely one where advanced automatic data processing could have been used to make the necessary calculations before the final decision, and could possibly have averted the collapse of the magazines.

Automatic data processing, used not as a clerk, but as a powerful aid to decision making, can actually turn the present art of management into a real science of management. Looked at in this light, it becomes clear that management which puts labour saving first has its eye on the wrong ball. More efficient operation and better control are the real goals. If labour is saved as a by-product, so much the better.

In the fourth stereotyped idea concerning automation—because automation is highly technical, it must be left to the technicians—we meet a not uncommon condition of our age: the overwhelmingly high regard for the technician. It has been pointed out time and again, that ours is an age of specialization, and a narrow 'professionalism' has extended from the sciences, and in some cases from the liberal arts, into business. The machinery of automation is, indeed, extremely complex. The science of communication and control,

on which it is based, is one of the most advanced branches of technology, and the computer is the most advanced piece of equipment yet built in this field. But nobody is asking the businessman to build a computer or to repair one if it breaks down.

These are jobs that only technicians can do. Management too has a unique function, and one that is, in its way, as complex and difficult, perhaps more so. It is the role of management to plan for, inspire and administer the best performance that an organization is capable of. Truly fruitful results from automation require a fundamental change in approach, an understanding that the best applications are not the result of mechanization or streamlining of existing procedures, and a willingness to rethink the problems of an entire business in terms of final goal and final product. These are not technical problems. They are problems of method, organization and attitude, and they require managerial imagination, skill and experience rather than technical proficiency. Automation, simply, is one of the critical areas in which management must manage.

The installation of automation equipment should not be made unless a thorough understanding of the business itself, and the functions and needs of its operations, underlies it. Most engineers underestimate both the importance of this point and the difficulties of grasping the complexities of modern business operations.

The question has often been posed: should we train engineers to be managers or managers to be engineers? Such a question, even when the technical complexities of automation are acknowledged, ignores the real role of management. Automation intensifies the traditional problems management has to face, the economics of a venture, and the equally commanding problem of industrial relations.

On the other hand, as I have pointed out, automation also provides the tools for reaching detailed and far-projecting decisions. The most critical problems facing management are not the technical problems, but the traditional managerial problems thrown into a new relief.

The economics of automation have been badly understood. At this point, I can only discuss very briefly some of the immediate financial considerations which must precede automation. I should like to highlight some of the areas management should be aware of.

An important reason why hoped-for savings from automation have failed to materialize is that management has not always been realistic about costs.

The trap is twofold. It consists partly in thinking of the machinery by itself and not recognizing the associated, often hidden, costs of applying it, and partly in starting to plan for the equipment by assuming that the cost must be justified by demonstrating immediate and obvious savings, primarily in labour costs. Since the most immediate and obvious saving is a reduction in labour costs, this consideration usually becomes the justification for buying the equipment and also dominates the use of it after it has been installed. In the process, the possibility of capital savings so substantial as to dwarf any conceivable gains from labour savings is overlooked altogether.

For example, in the case of a papermaking machine, the introduction of an automatic control system on the city-block-long equipment is not likely to remove a single man from the payroll, since they will all be needed to handle breaks in the paper, and to run the new equipment, yet it may allow an increase in the speed of the equipment from, say, 2,000 feet per minute

to 2,500 feet per minute. When this happens to an investment of ten to fifteen million dollars, the increase in productivity of the equipment results in a sizable decrease in the capital cost per unit of useful product in the manufacturing process.

Similarly, the economics of computer installations are badly understood. For one thing, management has failed to realize that the cost of installing a computer and converting existing procedures in most cases very closely approaches the cost of the computer. Briefly, this means that if you are planning to spend a million dollars for a computer, you had better count on spending an additional million dollars for planning, installation and conversion costs. These may not all appear in the direct cost breakdowns associated with the computer, but they are very likely to be real costs borne by the organization in assimilating the change. If you fail to take this into account, you are bound to be disappointed in the length of time that it takes the computer to pay for itself.

It is also important to understand that once the system is in, the largest expense will be the cost of preparing data for the machines. If additional useful information can be extracted as a by-product of something the computer is doing anyway, the economics may be enormously changed. That is why the payroll is seldom the best way to use a computer. To put it on the computer is in the first place complex and time-consuming, and once it is on, there is not likely to be any easy way for management to get additional useful data from this application unless it has been planned as part of a system having several objectives beyond the payroll preparation alone.

Finally, I am convinced that the fundamental problem automation poses for management is the problem of education. On all levels of working and living we need more education. Beyond retraining those who already have jobs, to prepare them for more highly skilled work, we must all face the larger problem of how we are to increase our resources of good engineers, scientists and trained technicians. This problem will grow more acute in the years ahead. We shall have to develop ways of making higher training available to those best suited to make use of it.

But the question of education goes far beyond better training for work in specialized fields. Many of the new jobs—the job of manager, for instance—will require an increasing ability to think and to judge; an increased education in the largest sense of the term. The role of management will widen, not narrow, as a result of automation and it would be a grave error to assume that the task is simply to train management in technical skills. Management must learn new skills it is true, but these skills are uniquely managerial and call for a very serious effort to define the qualities that are needed for successful management in an age of automation, and then to learn how we can both acquire and teach these skills. And this, to my mind, is the fundamental challenge of automation to the manager.

THE TECHNOLOGICAL AND ECONOMIC PROBLEMS OF AUTOMATION IN THE U.S.S.R.

K. KLIMENKO and M. RAKOVSKY

At the present time, Soviet industry is having to face a number of problems of vital importance to technological progress. Thus, the directives issued by the Twentieth Congress of the Communist Party of the U.S.S.R. on the sixth five-year plan (1956-60) point out that: 'in order to ensure future technological progress, increase productivity and ease the strain on workers, the rate of mechanization must be speeded up considerably and industrial production methods must be automated on a large scale. . . . It is essential to press on from the automation of separate units and operations to the automation of the technological processes in the workshops and the creation of completely automated plants.'

The increased interest now being shown in the automation of manufacturing processes is the outcome of this policy, which the Soviet Government is steadily pursuing in the field of technology. The progressive mechanization of the various technological processes which has been going on for over twenty-five years in all branches of industry has paved the way for the transition to automated production.

As a general rule, side by side with mechanization, there is still a certain amount of manual work involved in connexion with the operation and supervision of production processes. When a whole series of operations is mechanized, manual work is replaced by work done by machines and mechanical devices, so that it becomes possible to use, for basic and auxiliary operations alike, a set of machines for the manufacture of a given volume of goods; but here too, regulation and supervision of the manufacturing process require constant manual intervention. Automation, however, means the introduction of machines, which not only carry out technological operations but also ensure the supervision of such operations, and check the quality and accuracy of the machine work, the handling and even the packing of the finished article. According to Lenin, the replacement of manual work by machines '. . . is the essence of the progressive development of human techniques. The higher the degree of technological development, the more manual labour disappears and is replaced by a series of increasingly complicated machines. . . .' Automated production makes it possible, with the help of machinery, to ensure, a continuous manufacturing process, untouched by human hands, but under human supervision. This is a revolutionary change, not only in techniques, but also in technology and the organization of manufacturing processes.

Automation is no longer 'a technique of the future'—it is already a reality in Soviet industry. It provides the ideal means of perfecting manufacturing processes, raising the productivity of collective work, turning out products in plenty and, hence, of solving the most important economic and political problems involved in the building up of communism in the U.S.S.R. When account is taken of the most recent scientific achievements—particularly the

use of atomic energy for industrial purposes, the employment of semi-conductors, the development of radio-electronics, and so on—and in view of the fact that the latter will make it possible, in the very near future, to effect considerable improvements in the various automatic plants, it becomes evident that the prospects of automating production are really unlimited. Under the socialist economic system, social barriers are entirely abolished, as are certain anomalies which prevent the automation of all forms of production. In the U.S.S.R., automation is the outcome of the problems inherent in building up a communist society. Since systematic technological progress meets the workers' basic needs, they are wholeheartedly behind it. In a socialist system, automation not only reduces appreciably the amount of work required, but also makes working conditions far less arduous; in fact it does away with what is often very hard physical work by exercising control over manufacturing processes; hence the need to improve the technical qualifications of those employed in automated production. For such persons, the result is greater material well-being and removal of the barriers between physical and intellectual work, which is known to be one of the most important factors facilitating transition from socialism to communism.

One very interesting result of automation is that it makes it possible to meet national manpower needs more fully and to raise the workers' standard of living. Taking basic technological operations alone, it has been estimated that, under the present five-year plan, automation will make it possible to release some two million workers. The mechanization of accounting and computation will enable from 350,000 to 400,000 persons to be released and these will be completely absorbed by other firms or branches of industry. Moreover, since there is no unemployment in the U.S.S.R., automation promises to shorten the working day.

By increasing production capacity and output, automation greatly reduces production costs and thus ensures that the capital outlay involved can be recovered quickly. Such expenditure, sometimes very high in certain branches, is recoverable within two or three years, or even in a few months, as a result of savings made in production costs. Provisional general estimates show that, at the end of the sixth five-year plan, it will be possible to effect direct savings amounting to some 25 to 30 thousand million roubles on raw materials, fuels, electric power and wages alone, as the result of automation plans now in hand. In the iron and steel industry, for example, the development of automation will enable the foundries, within five years, to increase production by 2.5 million tons of pig-iron and 3 million tons of steel. In the mechanical engineering industry, automatic equipment will sharply reduce metal waste. With the same volume of manpower and raw materials, the automation of certain branches of light industry and food production will make it possible to increase the tempo and volume of production, to reduce costs substantially and to raise the quality, while ensuring that the factory workers enjoy improved and healthier conditions of work.

As things stand at present, a number of basic factors contribute to the development of automation in the U.S.S.R. Outstandingly important in this connexion is the large increase in the volume of production planned for the sixth five-year plan, as well as the fact that firms in many branches of industry have become specialized; this facilitates the creation of entirely automated mass production sectors, workshops and firms. The rapid tempo of electrification also plays an important part. The need to modernize or com-

pletely replace outdated equipment is also a telling factor in the extension of automation operations. The amount of equipment to be replaced is large, and its replacement and modernization must of necessity go hand in hand with maximum automation. All this will enable the output obtained with the equipment in service to be increased considerably and the objectives of the sixth five-year plan to be not only reached, but even exceeded.

The trend towards the automation of production in the U.S.S.R. is due to the Soviet Government's policy of releasing the maximum number of workers from unhealthy and arduous work. Working conditions are particularly hard and dangerous in the chemical industry, the petroleum industry and metallurgy. It is not surprising that these should be the branches of industry in which automation has developed most rapidly and, in some cases, reached a very advanced stage. For instance, when one of the workshops of the Efremov Synthetic Rubber Factory, where the use of mercury was found to be harmful to the workers, had been completely automated, it was possible for the whole staff to be withdrawn from the premises in question.

Striking achievements are also to be noted in the automation of some other branches of industry. For instance, all the hydraulic plants coming under the Ministry of Electric Power Plants of the U.S.S.R. have been fully automated and telemechanized to an extent corresponding to 65 per cent of their total capacity. In this ministry's large electric plants, the regulation of combustion in boiler units is automated up to 77 per cent of total steam-production capacity and 96 per cent of the stoking of the boiler units is automatically controlled. Large-scale operations are under way with a view to automating manufacturing processes in several branches of light industry and food production. Automation of new technological processes is most effective where the equipment is adapted to automatic control. Thus, in the first Soviet atomic power plant, the employment of absolutely reliable automatic controls has made it possible to regulate rapid thermo-nuclear processes. In mechanical engineering—the branch of industry in which it is most difficult to introduce automation—over 100 automatic production lines are now in operation, in addition to a great many automatic and combined machine-tools. Outstanding success has also been achieved in the automation of a number of other manufacturing branches.

It is interesting to hear what certain business representatives of capitalist countries who have visited the U.S.S.R. think of the automatic equipment being used in this country. For example, Neville L. Bean, one of the American experts who visited the industrial firms of the Soviet Union, told an editor of the review *Machinery* that the experts who had inspected the automatic production line at the State First Ball Bearing Plant had been amazed at what they had seen. 'Any technological organization in the world', said Mr. Bean, 'would admire such a perfectly designed production line.'

Technological advancement calls for automatic control of manufacturing processes and necessitates the creation and operation of various automatic instruments and devices, machines, sets of machines, automated sections and fully automated firms. Knowledge of the process of automation has become a *sine qua non* of technical efficiency. The invention of automatic remote control devices and means of protection against accidents has opened up entirely new vistas and has made it possible to resort to a number of technological processes formerly considered out of the question. It is, in fact, impossible to do certain

things by hand at very high or low pressure, at high temperatures or at very great speeds. Modern aviation—and particularly jet-propulsion—the manufacture of synthetic products, the catalytic processes of the chemical industry, steam production at high parameters, research in the field of nuclear physics and, lastly, work on the fuller use of atomic energy in industry have become possible only through the introduction of various automatic devices. Continuous processes in the iron and steel industry, chemistry, the petroleum industry and power plants require automatic control, because they are based on very strict adherence to a technological system which can be controlled only by intricate automatic machines.

That is why efforts in the U.S.S.R. to apply a new technique and to make technological progress in industry are primarily efforts to achieve complete automation of production. The solution of problems raised by such automation is bound up with the introduction of a wide range of standardized automatic measuring instruments and control devices. A big industrial firm needs a single, central control board which should be at some distance (anything up to several hundred yards) from the workshops and units; this means that there must be a considerable number of telemechanized devices; in the final count, it is remote control, combined with the use of regulatory machines and devices that determine the success of automation.

In recent years, Soviet industry has succeeded in producing a number of new types of specialized equipment. For 1956, the production of the factories of the Ministry for the Precision Instruments and Automation Devices Industry alone is estimated at over 28,000 electronic potentiometers, nearly 300,000 pyrometers, nearly 2,500,000 apparatuses for the regulation, recording and measurement of gas pressure and rarefaction, and nearly 60,000 different models of consumption meters and output regulators. Work is in progress on the production of radioactivity level meters and densimeters, vacuum gauges and radioactive and ionization pressure gauges, as well as other apparatuses of the very latest type. Devices are being made which use very high supersonic vibrations, radioactive rays, thermo-electric effects, the ultra-violet zone of the spectrum, and the photocolorimetric principle. Particularly difficult problems are raised by the construction of computing machines and devices which henceforth enable various technological processes or production units to be controlled automatically. Computers, for instance, will be used in mechanical engineering and particularly in the programme setting of machine-tools. In the most up-to-date examples of these machines, the original information is recorded on magnetic tape (or some other 'memorizing' system), from which the mathematically computed order is transmitted to the operating machines. Many metal presses and machine-tools, working to a set programme, will doubtless be widely used in the very near future in Soviet industry. The further technical improvement of the design of electronic machines will largely depend on the introduction of high-quality semi-conductors, the utilization of magnetic effects and radio engineering and also on research in physics and mathematics.

Owing to the introduction of automatic devices, machines can now replace, not only manual labour, but also some types of intellectual work. This branch of science—known as 'cybernetics'—is connected with the use of various electronic computers. The Soviet BESM machine performs 8,000 arithmetical operations per second, and the new machine at present being designed in the U.S.S.R. will be able to perform 20,000 operations.

Apart from the various computation problems which are particularly important in scientific research, electronic machines will open up enormous possibilities for the direct control of industrial operations on the basis of programmes set in advance, and also for the translation of foreign languages, bibliographical work, traffic control, and so on.

Integrated automatic systems are planned, from the outset, on the lines most conducive to subsequent development and maximum efficiency. Modern technology provides many opportunities in this respect. Thus, all technological problems involving closely allied principles can, even though they may arise in the most widely differing branches of industry, be solved by similar methods. Through such standardization of the simplest automatic devices, the latter can be combined to form the most diverse and intricate automatic units. Industrial materials intended for a great variety of purposes and differing widely from the technological point of view have many common static and dynamic properties. Thus, it is possible for open-hearth furnaces, diffusion apparatuses or saturators in the sugar industry, tunnel furnaces in the silicate industry, coke ovens and bakers' ovens to be classified in the same group. By studying the different production materials and classifying them scientifically, it will be possible to place many of them in a single group, which will make it far easier to develop efficient and reliable designs for integrated automation. Many other technological problems will have to be solved in the near future. Theoretical research has been undertaken in order to provide a scientific basis for the principles and methods of rational designing of automatic systems and, among other subjects, the theory of automatic regulation and control is also being studied. It cannot escape notice that often, in inventing effective and interesting automatic devices, certain questions connected with technology and the organization of production are completely overlooked. However, Soviet experience in operating many automatic production lines, and particularly that of a well-known automobile piston factory, has shown that it is not enough to establish a system of automatic machines; it is necessary to examine thoroughly and change radically the whole technological process and the order of work on the production line, to train qualified staff beforehand, to provide for the control of production operations and also for their complete servicing when required. In other words, the automation of production, as it is understood in the U.S.S.R., does not consist only in constructing various types of automatic machinery, but also includes the preparation of projects at a level suitable to the new equipment and the production system. At the same time, evidence of the economic soundness of the new automatic devices must be supplied and the most rational variant singled out.

Owing to its technological nature, automation in capitalist countries has certain peculiar features, which are an illustration of the competition between individual firms and the special ways in which the various branches of industry develop. Moreover, automation was first introduced in capitalist countries some twenty-five to thirty years ago and, at the present time, much of the automation equipment can be considered as out of date. Things are quite different in the U.S.S.R. Starting with the latest equipment, the Soviet Union can bypass whole stages in the development of automation. It would be a mistake for it to take account only of foreign trends and forms of automation. In particular, as has already been said, the U.S.S.R. should aim primarily at introducing standardized automatic units, combinations of which would provide all branches of the national economy with reliable, inexpensive and

relatively simple automated systems. This, of course, is feasible only where there is general planning of industrial development.

The automation of industry in the U.S.S.R. calls for extremely well regulated co-operation between scientific research institutes, designing offices, bodies responsible for studying projects and all ministries. Specialists working in universities and institutes have a very important part to play; their contribution to the development of automation will make it possible to establish industry on a firmer scientific basis and to raise the standard of training for specialists in the automation of production.

Naturally, in such collective work, the activities of the various people taking part must be closely co-ordinated. This task is entrusted to a special government agency—Gostekhnika, the State Technical Organization—which is responsible for directing all work connected with automation, adopting a single policy in the field of technology and preventing any wasteful duplication of work.

In view of the outstanding importance of automation to the national economy, all workers in Soviet industry and science are faced with a number of major economic problems. In the early stages, the main attention was centred on technical problems, but now that a certain amount of success has crowned the efforts made to develop different types of automation and the stage of its general application to the most diverse branches of industry has been reached, economic considerations are coming to the fore.

When once the most arduous, dangerous and unhealthy production sectors in the U.S.S.R. had been partially automated, the question of in what order the automation process was to be further applied naturally arose. This question cannot be answered except on the basis of a detailed economic analysis. It is impossible, for instance, to disregard the fact that there are in the U.S.S.R. several million persons engaged on loading, unloading and transport operations. Mechanization and automation would mean releasing 75-80 per cent of these workers. In the mechanical engineering sector, nearly two million workers are engaged on manual operations. The light industries and the food industries at present employ nearly four million persons, a figure which could easily be reduced by 25-30 per cent through partial automation, and by 60-70 per cent integrated automation. When weighing up the possibilities of automating any particular branch of industry, account must of course be taken of the technical level and degree of mechanization of the branch concerned, as well as of the extent to which the technological processes can be adapted to the requirements of automation.

The preliminary data obtained by extrapolation of the results of partial automation of certain technological processes shows that the period required for recovery of the capital outlay varies from eight months in some branches of industry to two years in others. The planning services of the Ministry for the Precision Instruments and Automation Devices Industry which have for several years past, been working out plans for partial automation, have reached the conclusion that the period required for recovery of the capital outlay varies between ten and fifteen months for most of the manufacturing processes in the chemical industry; between eighteen and twenty-two months in metallurgy; between ten and twenty-five months in the non-ferrous metals industry; between nine and sixteen months in the power production units (mainly in small electric power plants and thermal plants); and from fifteen to twenty months in the food industry.

For instance, the integrated automation of the Urals Aluminium Plant would cost close on 27 million roubles, while the annual savings thus effected would be about 20 million roubles. The integrated automation of the Dniepropetrovsk Electrode Factory would cost about 4.5 million roubles, and the resulting annual savings would be about 3 million roubles. The outlay for the installation of automation in a number of electric plants—the Bryansk, Shakhty, Vladimir and Kiev plants, and No. 11 thermal plant of Mossenergo (Moscow Power System)—was recovered in periods ranging from six months to three years. Automation costs of synthetic rubber and ammonium nitrates production are recovered within eighteen months to two and a half years and those of synthetic fibre production in as little as seven to eight months.

Another interesting point is that the annual economic yield deriving from the automative equipment is equivalent to about double its initial cost—which is a clear proof of the advantages of increasing the production of automatic equipment.

It is very important to distinguish between capital investment in scientific research work on automation and capital expenses that enter directly into the operating costs of the automatic plant and to keep the two separate. It is sometimes said that certain automatic production lines are expensive, but in fact much of the cost is due to the expenses incurred by the scientific and experimental work involved. For instance, the cost of equipment used in atomic energy production and more especially in sectors using computing machines is very high and is not immediately recoverable. It is more expensive to produce electricity by atomic power plant than by ordinary power plant; but this is due mainly to the outlay on scientific and experimental work, which is recovered gradually, as production expands. It is for this reason that Soviet economists consider that the costs of research and experimental work should be reckoned separately, and not be included in the production cost of the first automatic plant. When the cost of any new automatic production line is calculated, all the expenses involved in the project should not be included since, once the first tests have been made, many similar units can be set up on the same pattern.

Capital investments connected with the running costs of the automatic equipment are quite a different matter; these are naturally recoverable very quickly as a result of the rapid fall in production costs. Soviet economists propose that approximate dates should be set for the recovery of capital outlay for every different branch of industry and type of equipment; and that, over that period, the said equipment should be considered to be paying its way (5 to 6 years, for instance, for machine tools, and a longer period for power plant, etc.). These dates should allow for the economic aging of the equipment ('psychological' depreciation) as well as for technical depreciation.

The time-limits for the recovery of capital outlay affect the assessment of the economic yield of the automatic machinery. Experience shows that the automation of production in any form gives conclusive results. The best Soviet open-hearth furnaces, for instance, with partial automation and intensified technological operations, produce 10.8 tons of steel per square metre of hearth a day, whereas the corresponding figure for the U.S.A. is only 7.8 tons. Automation of the open-hearth furnaces in the Magnitogorsk metallurgical combine has led to lowering the fuel consumption by 5.8 per cent and the consumption of refractory materials by 13 per cent, with a 3 per cent increase in furnace productivity. In the case of blast furnaces, the use of humidified blast with automatic control and regulation of the parameters has made it possible to

raise the furnace productivity by 15.8 per cent, and cut coke consumption by 5 to 8 per cent. The amount saved in the synthetic rubber industry by automating the contact furnaces is about 10 million roubles a year; while the automation of the synthetic alcohol plant at the Sumgait synthetic rubber factory has increased the daily output of alcohol by more than 70 per cent, and halved the number of workers.

Frequently, the introduction of automation, besides cutting the costs of labour, materials, fuel and, consequently, also production costs, increases output and reduces capital outlay as well. Thus, the automation of a blast furnace costs 500,000 roubles, and puts the output up by 8 per cent. Hence, the result of automating twelve blast furnaces, at a cost of 6 million roubles, is equivalent to that of building a new blast furnace at a cost of about 100 million roubles.

In the production of artificial fibre, automation has made it possible to reduce raw material costs by 7 per cent, labour requirements by 26 per cent and production costs by 10 per cent, while at the same time improving quality and variety considerably. In the chemical industry, automation besides increasing productivity and cutting production costs, stabilized the technological processes, improved the quality of production, reduced breakdowns, lengthened the useful life of the equipment and appreciably improved working conditions. The following figures throw interesting light on the effects of the introduction of automation in a workshop producing ammonium nitrate: the staff was reduced by 35 per cent, wastage of ammonium by 9 per cent, and losses of nitric acid by 42 per cent; with these savings, the capital outlay on automation could be recovered in eighteen months to two years. The automation of the carbonization columns at the Donetz soda factory raised the annual production of soda by 42,000 tons, and the automation costs were recovered in six months. In the sugar industry, integrated automation produced a 7 per cent rise in the output of granulated sugar, with a 23 per cent reduction of manpower; in addition, labour productivity rose by 40 per cent, and the cost of automation was recovered in less than two seasons.

Automation in mechanical engineering produces particularly striking economic results. Thus, multi-spindle automatic lathes are twenty times more productive than ordinary universal lathes, and the extra cost of installing the automatic lathes can be recovered within two years from savings on wages alone. In many cases, moreover, the automatic multi-spindle lathes, the machine-tool units and the combined machine tools are cheaper to buy than the ordinary lathes. Automation is particularly effective when accompanied by the introduction of more advanced technological methods. For example, production can be stepped up scores or even hundreds of times in the manufacture of bolts by using cool-drawing automatic machines instead of lathes. On some of the best automated lines, productivity is increased from ten to thirty times with a 20-30 per cent reduction of labour costs.

The above data are, however, not complete, and do not give any idea of the real economic impact of automation. In this connexion, the working out of a sound scientific method for assessment of the economic advantages of automation now represents one of the major technical and economic problems of the national economy of the U.S.S.R. A precise definition of the indices, criteria and methods to be used for assessment of the effectiveness of automation must be found before the future general trends of the automation process can be mapped out. In practice, the most important index of the economic efficacy of

automation is the reduction of production costs; but it is not the only one.

The main factors to be taken into account in determining the efficacy of automation are labour productivity, production costs and the speed of recovery of the capital outlay. But there are a number of others, as automation also results in an appreciably lower accident rate, a rise in the cultural level of the workers, and an improvement of health and hygienic conditions, all of which most certainly cannot be ignored. Another advantage of automation is to reduce faulty workmanship, whether due to defects in the machinery, equipment and materials worked, or to unskilled labour or breaches of technological discipline. In addition, automation usually improves the quality of output, speeds up the production cycle and makes for better use of production capacity.

How does automation affect the work and lives of Soviet workers? Experience to date vindicates the theory of Soviet economists, which is that the automation of production processes will require not less skilled workers but on the contrary, in the majority of cases, more skilled ones, especially when the degree of automation is high. And this is an essential prerequisite for the introduction and effective utilization of new technical methods. Thus automation emphasizes the fact that the raising of the level of professional training is a basic condition without which the application of new, progressive technological processes cannot be extended. In a socialist economy, where both unemployment and over-production are unknown, automation helps to create conditions such that the cultural and technical level of the workers can gradually be raised to that of technicians and engineers. Automation, in fact, needs workers for technical supervision of the machinery, regulating and setting it, and doing repairs—all operations calling for a high degree of technical skill,

In the Soviet Union, the problem of the training of highly qualified personnel is a matter of national importance, and it is being solved at the national level. In the first place, universal and free seven-year schooling has existed for a long time. Under the present five-year plan (1956-60), the principle of universal and compulsory secondary (10-year) education is to be applied in the towns and rural centres. During this five-year period, the number of pupils graduating from the tenth classes of the secondary schools will be 6,300,000, or more than double the number for the previous five-year period. Thus the Soviet labour force will be steadily swelled by the addition of graduates of secondary and technical schools. Already in 1956, many new workers with a full ten-year secondary education took up jobs in industry; and there is no doubt that these new recruits possess the maximum potential ability to acquire intricate skills with rapidity and assimilate new technical processes, such as those connected with automation. A further contributing factor is that the secondary school syllabuses are becoming increasingly technical so that the schoolchildren receive a sound grounding in various technical subjects, besides some experience in manual work.

In addition to the general secondary schools there is also, in the Soviet Union, a vast network of secondary training establishments for young workers; these schools were set up in 1944 for the benefit of young people who, having for one reason or another been unable to obtain a general education at the normal time, now wish to improve their educational standard, without leaving their factory jobs. In 1956 there were 6,637 such schools in operation in the U.S.S.R., catering for about 1,400,000 young workers.

There is also in the Soviet Union a number of vocational training schools, mining schools and railway workers' schools for training skilled workers. The

students at these establishments are entirely State-supported. During the fifth five-year plan (1951-56), these schools and the apprenticeship training centres for industry, the building trade and transport turned out 1,736,000 skilled workers.

In conclusion, mention must be made of the vast network of courses and schools organized by Soviet enterprises all over the country. They include advanced vocational training courses, schools teaching the latest production methods, new techniques, etc. All forms of industrial training given in Soviet firms are free of charge. The question arises whether, with so vast a training system, automation may not lead to a surplus of qualified personnel. However, one of the advantages of the socialist economic system is that this danger, like that of unemployment, is precluded.

Automation raises the duties of workers to highly technical supervision over a complicated system of automatic machinery, and gives them scope for important creative work. Under socialist conditions of production, ever broader prospects are unfolding, and the way is open for workers to graduate to technical and engineering work of a scientific and cultural level.

In a socialist society, the need for workers in these two fields is growing steadily. How then is the training of these workers organized in the U.S.S.R.? In 1956, a total of 1,867,000 students were enrolled in Soviet higher educational establishments, almost fifteen times as many as in the corresponding establishments in Tsarist Russia, and 2.3 times as many as in 1940. There were also, in 1956, over 1,960,000 pupils in special secondary schools in the U.S.S.R., or thirty-six times as many as in Tsarist Russia, and twice as many as in 1940.

The extension of higher and secondary specialized education in the U.S.S.R. is facilitated by the fact that it is accessible to all. The Soviet State is extending the network of these establishments; since 1957, all instruction has been made absolutely free of charge (before that fees were very low); all students making satisfactory progress receive allowances, and there are hostels for those needing them. It is essential to add that there is also, in the U.S.S.R., an extensive system of secondary and higher special education by correspondence; and that many enterprises have organized special evening classes with the help of the higher educational establishments and technical schools. This enables workers to train as engineers, technicians, scientists or cultural workers while continuing in their regular jobs.

Thus the labour force is replenished by young people with a secondary education, and new engineers, technicians, scientists and cultural workers are recruited from former workers by a uniform natural process in accordance with the principles of an over-all plan which covers all branches of the socialist economic and cultural system, and even regulates the distribution of labour as between the various branches of the national economy.

Socialist production, which is based on the public ownership of the tools and means of production and which is subordinated to an over-all State plan, can be automated without harming the interests of the workers, because it serves the interests of the people as a whole, and not merely those of individual employers, as in systems where the equipment and means of production are privately owned.

It is precisely by virtue of the new social pattern of the U.S.S.R. that the automation of production, which constitutes an invaluable means of raising productivity and increasing the rate of industrial development, also leads to the betterment of working conditions by raising the material and cultural standards of

the working people. In the U.S.S.R., higher productivity and increased output lead directly to higher wages, cheaper manufactured goods and foodstuffs, and increased demand and expansion of the capacity of the home market.

Thus, as a result of the rise in real wages and frequent reductions in the prices of consumer goods on the state market—which had immediate repercussions on the collective farm market prices—the real wages of factory and office workers employed in the U.S.S.R. were, in 1956, 75 per cent higher than in 1940 (before the war); while the real wages of industrial workers were about 90 per cent higher. Even by 1954, the state retail prices were 2.3 times lower than in 1947 (the prices of foodstuffs 2.6 times lower, and those of manufactured goods, 1.6 times lower).

Thanks to the increase of labour productivity and of output, for which automation is largely responsible, the Soviet State is able, as befits a workers' state, to shorten the working day without reducing wages, It is in accordance with this principle that, during the sixth five-year plan period (1956-60), the working day is to be shortened to seven hours and even, in some branches of industry, to six. The changeover to the shorter working day began in 1956, and has not affected wages in any way. Again, the socialist economic system, based on planned, balanced development in all branches of production, paves the way for unlimited expansion of production. It is no mere chance that, in the U.S.S.R., the employment figures are rising steadily, despite the steadily increasing pace of automation. In 1955, for instance, the mean total of persons employed in industry was 48,400,000, as against 38,900,000 in 1950.

Under the socialist production system, where all the workers have a personal interest in results, automation of manufacturing processes makes work more systematic and more creative, improves working conditions, and raises the general cultural level. It also cuts down considerably the number of industrial accidents. It is true that some of the emulsions and oils used at present cause skin diseases among the workers. The changeover to different cooling methods is complicated by the fact that it is difficult to separate completely the lubricating system of automatic machines from the cooling liquid. But, as the experience of the Kiev automatic machine tool factory shows, there are good prospects of being able to use an improved emulsion as a cooling agent; and further work in this field will doubtless produce useful results.

Such, in broad outline, are the social factors involved in automating production in the U.S.S.R. socialist economy.

A large number of studies are at present being published in the U.S.S.R. on the economic problems of automation and on the organization of research into many complex aspects of this subject, which is regarded as an extremely important part of the general problem of the development of industrial and economic research.

TRANSLATING MACHINES

ANDREW D. BOOTH

Before the major subject matter of this paper is broached, there is one misapprehension which should be corrected: it is that, as far as is known to the author, no 'translating machine' as such exists at the present time. This does not mean that translation by machine has not been achieved but simply that up to the present it has not been found worth while to build a special machine for the purpose of translation. What then is the basis of the numerous reports which have been current to the effect that translating machines exist and have been used to perform translations from one language into another?

To answer this question we may perhaps go back a few years into the history of our subject. The possibility that a machine could be made to translate first arose during discussions which took place in 1947 between the present author and Warren Weaver of the Rockefeller Foundation. The motivation for these discussions was the fact that high speed digital calculators were coming into existence about that time and that the mathematicians concerned with the design and use of these machines were trying to find applications wherein the new devices would show their superiority to the well-known business and accounting machines which were their predecessors. The earliest proposals for machine translation envisaged only that a language could be handled in a simple dictionary look-up manner. That is, a segment of text would be presented to the machine, and the machine would then see whether the individual words, considered as complete entities, were to be found in its storage organ. In this event the meaning associated with those words was to be typed out. Any words which could not be found directly in the storage organ would be output by the machine in the original language version. As an example of this consider the following collection of words:

L'étude des fonctions définies par une équation différentielle . . .

Should these words be presented to a computing machine, the first operation would be to look up the word *L'*. This would be contained in the machine's dictionary and would be translated by some such output as *the*. In a like manner the word *étude* could be found as *study*, the word *des* as *of the*, but when the machine attempted to extract the word *fonctions* this would appear to be untranslatable since the word held in the dictionary would be the singular form *fonction*, that is without the *s*. In a like way the word *définies* could not be found. The resulting translation effected by the programme in 1947 would thus be:

The study of the *fonctions définies* by an equation differential . . .

It will be apparent that the method, though having a certain utility, left much to be desired.

On the return of the author to England, actual construction work was begun on a computing machine, and the interest engendered by these activities led to contacts with various other workers who were interested in the possibility of machine translation. In particular, Richens suggested that a way out of the

difficulties of the direct looking up of words in the dictionary could be found by storing only the stems of the foreign language words in the machine. The stem in this context having its usual definition as the longest segment of a word common to all of its parts. Naturally, even at this early stage, cognizance was to be taken of the fact that for many foreign language words, for example the French irregular verbs *avoir* and *être*, it would be necessary to store several stems, depending on which particular part of the verb was involved. The suggestion of Richens was that, having stored the stem of a word, the ending was to a large extent irrelevant and even if this was not so it would be sufficient for the machine to make use of the foreign language ending to give some grammatical note regarding the precise function of the word in the sentence. Thus, for example, *fonctions* would appear as *function* (p) where the latter symbol indicates that the word is plural. In the same way a verb such as *cherche* would appear as *seek* (1 pps) which would mean first person, present tense, singular.

Unfortunately, in common with all the other high speed computing machines which were projected with so much hope in the middle 1940's, the machine at Birkbeck College did not become an operational reality until 1950, and even when this occurred the storage capacity of the machine was still such as to make it impossible to do useful machine translation. For this reason, work on machine translation in England proceeded slowly, and the only practical trials which were attempted made use of standard punched card machinery. These trials were so unspectacular, and gave results so much in accord with those predicted, that it was not thought worth while giving them any publicity.

In 1953 the first international conference on the machine translation of languages took place at the Massachusetts Institute of Technology. It was at this conference that workers in Great Britain discovered that there was considerable interest in machine translation on the other side of the Atlantic. So far as actual achievement was concerned, both sides were about even. In this country a small practical trial had been made but the methods of linguistic resolution which went into it were of a simple nature. On the other side of the Atlantic considerable linguistic investigation had been carried out which purported to show that machine translation was difficult if not impossible. To sum up the position at this stage, it is probably fair to say that the British workers considered that any experiment which could be carried out was worth while and might lead to an extension of the range of the subject, whereas American workers were concerned with the thought that machine translation would be difficult and that, furthermore, unless it could be done with extreme perfection it was hardly worth doing at all.

Following the conference, a practical demonstration of machine translation was carried out by the International Business Machine (IBM) Corporation with the assistance of Dr. Leon Dostert of the University of Georgetown. This effected a translation of some Russian sentences making use of a restricted dictionary of about 250 words. In 1955, work in this country was greatly stimulated by the generous grant, by the Nuffield Foundation, of an award which enabled Birkbeck College, University of London, to pursue machine translation on a more ambitious scale than had hitherto been possible. In particular, it made it possible for the computational laboratory to enlist the services of skilled professional linguists. With the advent of the linguists, and with the computing machine APEXC in a working state, progress on machine translation became very rapid. A number of machine programmes taking

account of all the suggestions which had previously come forward were constructed by the present author and by Dr. K. H. V. Booth, and these formed a useful basis for the work. At an early stage it was necessary to decide what language or languages were to receive the full force of the linguistic attack. The decision for this selection rested with the present author. In view of the fact that the Americans were believed to be actively engaged in the study of Russian, and that the converse was true of the Russians themselves, it was decided to work on the French language. The reason for this decision lay simply in the fact that both the present author and his mathematical assistants were acquainted with this language and could therefore talk on the grounds of familiarity, if not of equality, with the professional linguists. In the course of some six months, Mr. L. Brandwood, Nuffield Fellow in machine translation in this laboratory, produced his first version of a set of grammatical and syntactical rules for the resolution of the French language. These were subsequently developed until now it is not unfair to say that the problems attending the resolution of French scientific texts have been solved. The further extension of this work depends not so much on the discovery of some new principle but merely on the demonstration by linguists of deficiencies in our existing programme and on the drafting of the rules on which the rectification of these errors is to be based.

Before going further we may give here a short example of the actual work produced by the machine when applied to a French text. The following example is taken from the first chapter of the third volume of Goursat's *Cours d'analyse mathématique* and the translation given below is that produced by the machine in accordance with the rules provided by Brandwood.

> Nous démontrons dans ce chapitre le théorème fondamental de M. Poincaré, après avoir étudié les intégrales d'un système d'équations différentielles, considérées comme fonctions des valeurs initiales. Cette étude a déjà été faite, dans le cas où les seconds membres sont des fonctions analytiques. Nous la reprenons dans le cas général, au moyen de la méthode des approximations successives de M. Picard.

> We demonstrate in this chapter the fundamental theorem of M. Poincaré, after having studied the integrals of a system of differential equations, considered as functions of initial values. This study has already been made, in the case where the second members are of analytical functions. We adopt it in the general case, by means of the method of successive approximations of M. Picard.

It will probably be admitted from the examination of this small example that the machine translation is indistinguishable from that produced by many human operators. Particularly is this true if the human operator is a linguist and not a professional mathematician, who would in fact re-write the passage in standard mathematical English. A number of persons to whom this translation has been shown without explanation gave it as their opinion that the translation was done by a human being, and expressed great surprise on hearing that it was in fact done by a machine.

At this point it may be worth while spending a small amount of time describing the machine as it exists at present. APEXC is a typical example of a medium speed digital calculator. Its storage organ takes the form of a magnetic drum which has a capacity of 8,192 words. These words are composed of 32 binary digits and this means, in effect, that each computer word can store six alphabetical characters coded in standard international teletype code. For this reason it is necessary, in practical translation, to take at least two computer words for each foreign language word and the same number for the translation. This in turn restricts the possible number of foreign language words which can be held in the present computer store to something of the order of 1,800. In practice far fewer than this number has been put on the drum since there has been no attempt to use the machine for what might be described as practical commercial translation. Any number of words, from the number contained in the single sentence under examination upwards, is adequate to demonstrate principles. The arithmetical portion of the machine consists of units to perform the operations of addition, subtraction and multiplication, together with certain shift operations and discriminations which are necessary to make the machine obey a set of instructions in a manner which is not known initially to the person who is setting the problem. The input to the machine is via a teletype tape read by a mechanism capable of absorbing 25 alphabetical characters per second and the output is handled by a punch which is capable of the same speed. The whole unit consists of some 450 thermionic valves, occupies about 4 square feet of floor space, and has a power consumption of between 1.5 and 2 kilowatts.

Mention has been made of the inadequate storage capacity of the machine and also of the word length. Inadequacy of storage capacity was a problem which was present in the minds of experimenters from the earliest conception of machine translation. The method proposed for overcoming the difficulty was that of the 'idio glossary'. This is simply a collection of the most frequent words which occur in the specific subject of the text under translation. Certain early estimates suggested that about 1,000 words specific to the subject in hand, and about the same number of words of general linguistic usage, would make possible the translation of over 90 per cent of the given text.

It has already been pointed out that words are divided, from the dictionary point of view, into a stem defined in the manner described above, and an ending. Since the early days of machine translation a more sophisticated approach than the original one of meaning plus a few grammatical notes has been evolved. In this method the machine contains two dictionaries, one of stems and one of endings. If these are stored separately, it is clear that $m \times n$ words become comprehensible to the machine for a storage of $m+n$ stems and endings so that if, for example, n and m were each 100, some 10,000 words would be comprehensible for the storage capacity of only 200 stems and endings.

The way in which the machine deals with a foreign language word may be of interest. When the word is presented to the machine it occurs, of course, as groups of binary digits and these in effect constitute a number. The dictionary words in the machine are stored in consecutive positions in ascending order of numerical magnitude. The earliest proposals for looking up an unknown word in the dictionary required that the word (expressed as a number) be subtracted in turn from the words listed in the dictionary, starting at that word having the least numerical significance. It is clear that at the beginning of the dictionary the result of the subtraction will be negative, that when the

exact equivalent is found the result will be zero, and that for words of higher numerical magnitude than the given word the result of the subtraction will be positive. The unknown word finds its match at the point when the result of subtraction turns from negative to positive. This proceedure will require on the average half as many look-up operations as there are words in the dictionary, so that if the dictionary contained say 10,000 words, and the look-up rate was 50 words per second as is the case with APEXC, the actual time required to locate a given word would on the average be 100 seconds.

A modification of this procedure, which saves a considerable amount of time, occurred to the present author. This method makes use of the well-known principle of bracketing. The unknown word is first subtracted from that word which is halfway through the dictionary. If the result is negative it follows that the unknown word lies in the second half of the dictionary; if the result is positive it is known that it lies in the first half. The operation is repeated at that word either one-quarter or three-quarters of the way through the dictionary and this in turn leads to a further partition into one-eighth, three-eighths, five-eighths or seven-eighths. It is easy to show that after $\log_2 n$ look-up operations the unknown word will have been located exactly. Thus, for example, in the dictionary of 10,000 words previously mentioned, some 14 look-up operations would be adequate; for a more extensive dictionary of one million words the number of look-ups is still only about 20. It follows that the time taken to locate any given word in the dictionary is reduced to about half a second. The subtraction process, of course, will give zero result only if the foreign language word finds its exact counterpart in the dictionary. When it turns out that the stem only occurs, things are so arranged that a transition from negative to positive occurs at that point in the dictionary when the true stem is being tested. At this juncture of the process, the equivalent of the foreign language word is to be found in the same storage location as the stem and could, in principle, be typed out. In practice it is retained stored away and the ending, which is the portion of the foreign language word which remains after the subtraction of the stem, is tested by comparison with the ending dictionary. The ending dictionary gives: first an indication of the ending which should be affixed to the English stem, and second an indication of any prefatory words which should be added. Thus, for example, in the Latin word *amas* the stem would be *am* and the ending *as*. These would lead to an English stem *lov*, and an English prefix and affix respectively of *thou* and *est*. The machine operation would thus result in an output of the phrase *thou lovest*.

The foregoing treatment has assumed that words can always be translated as they stand; in practice this is not so. The most elementary examples in the French language occur in the inversion of the order of nouns and adjectives which are often present: furthermore complicated pronoun structures such as

Je le lui donne
Je ne le lui donne pas
Je ne vous le donne pas.

mean that the machine has to perform extensive rearrangement of the English text if it is to make sense in that language. All these things are achieved by having the machine absorb the foreign language text one sentence at a time. The machine operations then result either directly in an output, if this is known to the machine to be possible, or alternatively in the accumulation and

rearrangement of the English words in the machine storage organ prior to output in sensible English order.

A word may be appropriate at this point concerning the treatment of idioms, which are of two kinds: grammatical and verbal. Both can be treated by a similar process, in which when the computing machine sees a word which may form the key word to an idiom it suspends any translation operation until it has made an analysis of succeeding words to see if these are in fact idiomatic. For example, with the French idiom *boîte de nuit*, the machine would first see the word *boîte*. This might be translated as *box* or alternatively may form the basis of an idiom. Machine instructions say quite simply: examine the next two words, if these are *de nuit* then ignore the normal translation and produce the translation *night-club*. If on the other hand, for example, the words were *de chocolat*, then the output would be *box of chocolate*.

Enough has probably been said to show the way in which the machine operates, at least in the non-technical manner, which is all that can be done in an article of this sort. There are two other points which should receive mention, however, and these concern the resolution of ambiguities, and translation between several languages. It was mentioned earlier that the dictionary to be held in the machine was restricted by inserting only those words which were known to occur in texts dealing with the subject of the material under translation. This idea, too, can be extended to enable ambiguities to be removed so that for example the French word *noyau* in nuclear physics would usually be translated *nucleus* whereas for other subjects it might be translated as *nut*, *kernel*, or *centre*. This type of ambiguity resolution is sufficient in most cases where the subject of translation is known. When, however, the subject of translation is unknown, as in a literary text, then another procedure can be adopted. In this, each noun in the passage to be translated has associated with it a so-called 'category number'. In the case of ambiguities, several category numbers will accompany each noun and these category numbers will be associated with each of the possible different meanings. When an unknown text is presented to the machine, it first runs through this text and accumulates the number of times the category numbers associated with each noun occur. In the case of those nouns which are unambiguous, and there should be many, large category count numbers of a particular type will arise. The ambiguous nouns are then translated by those variants which have the same category number as that which occurs the maximum number of times unambiguously. From some trials it appears that this method of ambiguity resolution has a wide application and will lead to an adequate clarification in most cases. Yet another means of helping with the resolution of ambiguity, although not of removing it, is to replace all the possible translations of the ambiguous word by one translation, which has that meaning which is nearest to all the possible meanings. Again, in the case of words which have been tested, this procedure appears to offer promise. When translation between several languages is considered, the major new problem is that of volume. If, for example, bi-directional translation is required between each pair of languages selected from a group of n; it is clear that $n(n-1)$ sets of dictionaries and machine instructions will be required. To reduce this somewhat prohibitive volume of linguistic work to more practicable proportions, it has been suggested that an intermediate language, M say, might be used. In this event the number of sets of data is reduced to $2n$ for the situation defined above. The proposal to construct, artificially, such a meta-language

can be rejected on two grounds: numerical and logical. In the first place, if any one of the original n languages is taken as the meta-language, the number of sets of dictionaries and instructions at once reduces to $2n-2$ which is certainly less than $2n$. And secondly assuming that M is such that it makes possible—as it must—accurate translation between all language pairs, it reduces itself, in fact, to a process which is at least as complex as that which uses one of the original languages as the basis for all translations between other language pairs, and is more complex for translations in which the basic language is involved. It is not possible, at the present stage of development of machine translation, to decide on the particular language which is to be chosen as the basis, although the volume of printed work would strongly suggest that it should be English.

At the present time work is proceeding with the resolution of the German language. The basic syntactical operations have been studied and codified by Oswald and Fletcher. Brandwood, in this laboratory, has extended their treatment to cover grammatical analysis and, so far as can be seen, with a machine which has adequate storage facilities and computing speed, the problems of German will yield in much the same way as those of French, at least so far as the scientific literature is concerned.

What now of the future? It has recently been announced that in the United States a machine specially for the purpose of translation is to be constructed at great cost. According to the rather meagre press reports so far published, it appears that this machine will simply take the form of a dictionary and will not make use of any of the extensive work mentioned above. Our feeling is that for a relatively modest sum of the order of £250,000, it would now be possible to produce a translating machine which would be potentially applicable to any language as soon as the linguistic work is done, and which would be immediately applicable to French and German and probably to Russian. This machine would have a storage capacity of about 100,000 words and would have an output speed of about 50 words per second. It could be constructed in a period of about two years assuming that the sum of money mentioned were available. It would differ from our present high-speed digital computing machines in only a few particulars, these being an extended storage capacity, the provision of high-speed alphabetical printing, the removal of the multiplying unit which forms a complicated part of most computing machines, the extension of the word length to something between 100 and 200 binary digits and the provision of one or two auxiliary operations which would enable the machine to detect parts of words and parts of sentences more readily than is the case at present. One other question which may be worth consideration is the provision of adequate input facilities. In the present machines and in that just envisaged, input would be via a standard teletype tape, which, of course, would have to be prepared for any new text. Work is at present proceeding on the development of devices for the direct reading of printed characters and for the direct recognition of spoken words. Our particular approach makes use of the extensive logical facilities implicit in the structure of an electronic digital computing machine and it is hoped that within the next two years a practical working character-recognizing device will be available. Spoken word recognition is still at an early stage, although even with the present techniques the digits 0 to 9 can be recognized with almost complete accuracy so long as they are spoken by one person. Probably in the long run it is by the development of such techniques as these that the translat-

ing machine of the future will become not only a reality but also a very practical addition to the armament of such organizations as the United Nations. The prospect appears interesting, particularly when it is realized that a single machine can deal with the whole gamut of languages once the initial coding has been carried out. The storage space required on paper or magnetic tapes for the programmes for all languages would be quite modest, and would greatly reduce the difficulties involved in assembling large numbers of human translators for various languages at short notice.

PART II

ORGANIZATION IN THE SOCIAL SCIENCES
NEWS AND ANNOUNCEMENTS

I. CURRENT STUDIES AND RESEARCH CENTRES

AUTOMATION AND THE INTERNATIONAL SCENE

DAVID A. MORSE

Automation is one of the many technological developments making profound changes in production, work and human life and inexorably shaping the pattern of the industrial society of tomorrow.

The new technology is a key factor in the present world situation. It has given us a powerful lever for economic and social growth. At the same time it is disrupting many old ways of work and life and adding to the elements of social instability which beset many aspects of modern industrial society.

Automation, atomic energy and other technological developments respect no national frontiers. They move from one country and area to another with the unexpected logic and strength of material forces. And their migration raises international as well as national problems.

Thus, technological change is of vital concern to every international organization. Each organization has a responsibility to study the impact of change and a duty to try to grasp the new opportunities and to meet the new problems which arise out of it.

What then are the international problems likely to require attention as the wheel of change spins over the next few years? They are, I think, many and various. Here I will seek to identify some of those of particular concern to the ILO. Each other international organization could add to this list problems preoccupying it as the world crosses the threshold of the new technological era.

In the international field, there has been convincing evidence of increased concern with the labour and social implications of automation and other recent technological developments. Indeed, perhaps the most significant tendency of the last few years has been the recognition that the impact of technology on people is something that requires urgent and sustained attention. Technical problems can be solved. Financial problems can be overcome. But human problems tend to be more stubborn and more difficult both of analysis and of solution.

Nevertheless, the significant fact is that these problems are now receiving far more widespread attention than at any previous period of our industrial evolution. This in itself augurs well for the future.

At the last two sessions of the International Labour Conference, I was struck by the keen and lively interest of delegates from all over the world in the impact of automation on social policy and on the relations between management and labour. It was evident that the problems differed to some extent from one country to another with national traditions, systems or conditions. Yet, despite these differences there was full agreement that the introduction

of automation into the world economy had far-reaching international implications which needed to be kept under continuous study and review. This, in fact, was the sense of a resolution adopted by the Conference in 1956.

Chief among the problems of international concern is the question of employment and unemployment. Experience has shown that unemployment anywhere tends to undermine employment everywhere. There is such a thing as the world employment situation. The situation in every country acts and interacts on it, and no national situation is unimportant from the standpoint of world economic and social health and prosperity.

Clearly, much of the apprehension about automation derives from the fear that unemployment is a necessary concomitant of technological progress, that increasing productivity brought by automation will be transformed into unemployment instead of into rising living standards. Will automation widen the gap between production and employment? Will production outrun markets and give new force to elements of strain that eventually lead to a depression spreading from one industry and country to another? Have the fears that this will be the course of events any basis in fact?

These questions are not easy to answer. But I think that it is important to try to seek the elements of reply. First, looking at the world employment situation as a whole and from a long view, it seems clear that technological progress has not reduced the over-all level of employment but has tended to raise this level. Fresh needs and opportunities have arisen. Secondly, only thirty years or so ago we were not clever enough to prevent a world depression. Can we do so now? The answer is that in principle we can: the means for maintaining full employment have become more varied and more effective than ever before in industrial history; the social demand for full employment has never been so great. Whether we have the social will and the capacity as a society to use these means properly and fully, should the need to do so arise, only time will tell. Thirdly, so far the progress of automation has not caused any large-scale displacement of workers in any country. That is the fact of the present world situation.

To look at the matter more positively, the primary impact of automation on employment is likely to be to create new opportunities: new opportunities for management and for workers, new opportunities for consumers as well as producers, new opportunities for educational and skill development, new opportunities for leisure and for work, and new opportunities for human co-operation.

Automation holds out great savings in labour. I do not think that we should be afraid to admit this or fearful of the consequences. We can spend these savings in higher output—either in the same or in other sectors of the economy —or in greater leisure or in a combination of both. We need not squander them in unemployment.

Thus, it seems to me that the real problem for solution is that of social adaptation to the changing pattern of *opportunity*. This involves adjustment to changing employment and skill patterns and to changing patterns of work and life brought into being with the greater economic potential deriving from automation.

One of the main areas of change which we will have to study in the immediate future is the over-all effect of automation on the composition of the labour force. How will it change skill requirements? How will it alter the proportions of

skilled, semi-skilled and unskilled workers, of manual and non-manual workers? What will be the effect on employment opportunities for women or for older workers or for members of minority groups? What will be the impact on youth employment? These questions are important and they have clear international implications. There has been a good deal of speculation as to the future trend of events but, so far, too little serious study of the factual tendencies.

Adjustment to changing employment and skill patterns is not an easy task. A good many human problems are likely to arise. Some of the displaced workers may not have the opportunity or the capacity to fit into the new jobs opening up with automation. Some areas of skill will disintegrate and difficulties will arise for the older skilled workers who cannot adjust easily to radical changes and who fear downgrading as a result of change. Skill development is sure to require great changes in educational content and structure and in methods of training at all levels: many problems in this field are already apparent. International problems will emerge. A greater need for international mobility of labour may well result from changes in the pattern of industrial activity, from national employment and skill changes and from the prevalence of skill shortage. This may be particularly true in Europe and in the less developed countries.

All these various changes in the labour force and in employment and skill patterns are of world-wide concern. How can we ensure that the changing structure will promote greater human opportunities and provide greater possibilities for the release of creative human energies? Surely these are questions that must be answered in international as well as national terms.

Automation is bound to reinforce current pressures for and tendencies towards higher wages, shorter hours, longer vacations and so on. It will also affect the course of social security, for social security is still largely a matter of protection from needs created by or influenced by technological advance. At first sight, social policies in these various fields would seem to be national in scope. But what of their impact on international competitive relations? Are they not likely to have clear international repercussions which may indeed become more important as automation extends its range in the more industrialized countries?

Further, what of the impact of automation and other forms of technological change on the social growth of the less developed countries and on the relations between these countries and those already far advanced along the path of industrialization? This is one of the key international problems of our times.

Here again it is easier to raise questions than to answer them. But certain things can be said. For one thing, automation and other technological 'breakthroughs' hold out great promise of industrial growth to the less developed countries and suggest a means of overcoming the age-old problems of poverty and population pressure. Even today, automation is being applied in some plants in certain industries in the less industrialized countries—in Asia, Latin America and the Middle East. Already, it is having an impact on the methods planned for the future expansion of particular industries—such as chemicals and engineering. At the same time, industrialization alone imposes severe strains on the social structure in these countries. Are these strains greater when the transition is from a relatively primitive economy, not to a simple industrial economy gradually becoming more complex, but to a far more highly advanced economy?

It is easy to jump to conclusions on this point. But honesty should force

the admission that there is as yet no solid basis for drawing any final conclusions one way or another. Some argue that automation would tend to facilitate social adjustments in less developed countries, that this type of technology is easier to absorb than mass production of the conventional kind, and that the intellectual effort required to run automatic factories is easier to furnish than the mechanically minded skilled workers needed to operate old-type plants. Others argue that automation is more likely to accentuate tensions already evident in the process of industrialization of these countries and to give new ground for industrial and social unrest. In particular, it is alleged that automation will aggravate the chronic problem of under-employment and unemployment. Still others point either to the difficulties of capital accumulation for development purposes or to the inherent conservatism of underdeveloped societies as factors impeding any rapid or effective application of automation. But none can argue convincingly from widely based experience extending over a period of years.

My own tentative conclusion would be that the new technology typified by automation need not make things more difficult for the less developed countries—it may in fact make the solution of some of their labour and social problems easier—but that it is likely to create some difficult transition problems unless there is a great deal more conscious attention to the human problems of change in traditionally minded societies. In other words, I do not believe that the failure to apply advanced technology will solve any problems over any long period of time; but I do believe that the application of such technology offers some prospect of solving them but requires a good deal of sustained social effort and, in this connexion, a considerable improvement of labour-management relations. Again, the question is: can we make this effort?

Finally, it may be suggested that, despite what may be done through the application of automation to accelerate the process of economic development in the less advanced countries, there is a danger that automation, over the world economy as a whole, may contribute towards widening the gap between living standards in the highly industrial countries and those in the less developed countries and may thus accentuate the tensions already evident in the international situation. This may well be the case unless more is done to promote more even world development and to make available to the less developed countries on a larger scale than heretofore the components of industrialization, in particular capital equipment and technical know-how.

In all these areas of changing social and international relationships evolving with the progress of automation and other recent technological developments, there is an urgent and important task for international organizations. Indeed, one of their most important functions is to promote orderly social adjustment to the changes taking place in the bases of society which in their turn give rise to so many political, economic, social and human problems in the world community.

The ILO, for its part, has a particular responsibility to further among the nations of the world policies and programmes which will lead to steady improvements in working and living conditions and to provide such practical help as it can in this broad area of action. It has to study the impact of automation on these conditions and to bring into play, as may be necessary, such parts of its machinery as can help to cushion the transition and promote solution of the labour and social problems which arise.

First of all, the ILO is trying to focus attention on the problems and to provoke discussion of them. My Report to the 1956 Session of the International Labour Conference referred to the social problems arising with automation and other recent technological changes. The Report to the 1957 Session concentrated on these problems. There was a full and interesting discussion of the labour and social implications of automation and many suggestions were made as to the lines along which our future activities could best be directed so as to contribute most to the solution of the problems involved. It was particularly interesting to note the views of representatives of the industrially less developed countries, which reflected the conflicting hopes and fears to which I have already referred—the hope that automation might provide a short-cut to greater prosperity and higher living standards and the fear that it might aggravate an already acute problem of unemployment or under-employment.

Secondly, the ILO is studying and reporting developments. It is studying what is happening in some of the major world industries—for instance in the metal trades, in iron and steel and in the chemical industries. It is studying the impact on particular groups of workers, such as white-collar workers or young workers or women or the handicapped. It is studying the labour and social implications of automation in all of the technical fields for which the ILO is responsible. These studies are not academic. They are a step in analysing the problems. They are necessary to further action.

The ILO Industrial Committees are discussing automation in relation to the special problems of the world industries with which they are concerned. Some of the regional conferences and technical committees of the ILO may do so as well. In accordance with a suggestion by the ILO Conference the Governing Body has decided to convene in 1958 a small tripartite meeting to examine the problems in more detail and offer guidance as to future policy and activities. It is more than likely that certain kinds of technical assistance may also be requested from the ILO in the years to come because of progress towards automation in our member countries. Our developing labour-management and workers' education programmes are being worked out with full regard to the importance of changing technology as a force influencing the structure and content of labour-management relations and trade union activity in the different countries.

Finally, the ILO is giving special thought to the problems of the less developed countries. What can be done to narrow the frightening gap between living standards in these countries and living standards in the older industrial countries? How can the new technology be put to work in the fight against poverty? How can the social problems of adjustment to automatic methods of production best be met? What adaptations are needed in the structure of management and labour in these countries?

The ILO is planning to intensify its activities so as to be able to provide every assistance it can in meeting the problems of the automation-atomic energy era and in the general efforts to make sure that social goals triumph as the new technology makes its way into the world economy.

I should not wish, however, to over-emphasize the role of the ILO in relation to the opportunities and problems brought by automation. Each international organization has an important part to play. And the task is one requiring the co-operative effort of all the organizations. It is, I think, clear that automation and atomic energy make more necessary than ever the increasing co-

ordination of international work that has characterized these last few years. A vast effort must be made if we are to respond constructively to the new needs and conditions coming into being with the technological revolution now in process.

We need more than just inter-governmental effort, although co-operation among governments is a first condition for true international progress. Broad understanding and participation by the people themselves is important in the smooth absorption of technological change. Any industrial society maintains a delicate balance in a period of rapid change. Conflicts of will and opinion, national and international, are bound to arise; and they must be brought into the open and, where possible, resolved. Thus automation reinforces the desirability of seeking a high degree of social co-operation among the peoples of the world. In this area of policy as well, the international organizations have the task of providing the means for encouraging the exchange of views and experience which is necessary to an honest appreciation of the problems before us.

My general conclusion would thus be that automation and atomic energy, symbolizing as they do the technological forces changing our patterns of work and life, will give fresh impetus to international co-operation of all kinds. At the same time, we must never forget that the success of all international effort resides in final analysis on national efforts. Working together, nationally and internationally, we shall be able to ensure that our social attitudes and institutions change with the times and that technological progress is translated into social progress. If we do not give evidence of a greater capacity to work together to harness the new forces we have released, our whole civilization will bend and may even break under the strain of technological change. There is much to be done; but I am sure that, despite the many barriers to co-operation which now exist, much *will* be done and that we will be able to meet successfully this challenge to our society.

RESEARCH INTO THE SOCIAL EFFECTS OF AUTOMATION

J. R. GASS

Research into the social implications of automation is rapidly expanding. An important reason is that, perhaps for the first time, a clear and unequivocal demand has been made on the social sciences to provide factual information for public policy. This situation of rapid growth in response to expressed public need is novel in the field of social research. It presents an opportunity, but in view of the small corps of competent research workers, especially in Europe, there is the danger that the demand for studies on automation can only be met at the expense of other important work, and to the detriment of balanced development of social science research as a whole.

This danger is most likely to be overcome if the research efforts in different countries can be complementary and therefore economical of research man-

power. A co-ordinated programme is perhaps too much to ask, but there should be an immediate effort to clarify research problems and exchange information on research plans. This article will, it is hoped, make a contribution to that end.[1]

The Dangers and Delights of the bandwagon

To investigate the explosive growth of public concern about the social implications of automation would be a worth-while full-time research project in itself. Some of the main features can, however, be stated. The Congressional hearings in the United States of America are well-known [1].[2] In the United Kingdom, labour redundancy in the motor-car industry sparked off a public debate which still continues, The French Conseil Supérieur de la Recherche Scientifique has set up a Bureau d'Études de l'Automation. The official Productivity Centres in Belgium, France, Denmark and Sweden are known to be actively concerned. The major international organizations, ILO, OEEC (especially the European Productivity Agency) and Unesco, have likewise expressed their intention of examining the problem. Despite the speed with which the pressure to formulate policy has built up, the basis of fact for such policy remains meagre in the extreme.

A situation has thus been created in which automation may become something of a research bandwagon. Although those who are in a position to make a research contribution may enjoy the somewhat heady atmosphere in which their efforts are so obviously in demand, there is inevitably a sneaking feeling that they will be led up blind alleys of research. One has seen the research worker, provided with project and funds, looking somewhat vainly for some real automation to study. Disclaimers by leading technicians to the effect that automation has no technical reality are also to be observed.

The true nature of the problems, and their importance relative to others, will only emerge when the social problems of automation are related to existing knowledge. We must be clearer about the degree to which automation poses old problems in a new and bigger edition, rather than raising novel issues. For a start we can take it for granted that many fields of existing research knowledge are relevant to automation: the problems of economic growth due to technical innovation are not entirely unstudied; nor are those of a social character arising from the introduction of technical change. There are very big gaps; but there are also volumes gathering dust on the shelves. A very important task for the research worker is to marshal this existing knowledge from the point of view of its relevance to automation. This would surely be to the practical advantage of those in industry and would lead to more fruitful research effort.

In one sense the so-called problem of automation is merely the problem of an increased rate of technological change. This is true of the effects on employment, wages and hours of work, of capital accumulation and of the strains caused by varying rates of productivity change in different sectors of the economy—the very matters which have been so much discussed in public. These effects are common to all forms of displacement of labour by capital equipment; the problem is one of adjustment to a faster rate of productivity increase than

1. The author recognizes a bias towards United Kingdom activities in the research reported. This was inevitable because of the short notice at which the article was prepared. He would welcome information on work that has escaped his notice.

2. The figures in brackets refer to publications listed in the bibliography at the end of this article.

in the past. Prediction of these effects requires assumptions about the rate of technological change, and analysis of the way in which the economic system adapts itself to productivity increase. There is, however, a second and more or less independent set of social effects, such as those on skills, satisfactions and organizational forms, which are peculiar to a particular form of production technology. The pattern of human organization which matches the technical features of automatic production may raise issues peculiar to automatic processes.

The distinction between these two categories of effects—those arising from productivity increase and those resulting from the interplay of human and technical considerations (the human/technical equation)—is especially important in the discussion which follows.

SOCIAL EFFECTS OF PRODUCTIVITY INCREASE

Productivity increase, and its effect on employment, wages and working hours, has received and is receiving most attention in the United States.[1] This is to be expected since rapid productivity growth due to technological change is more marked in America than elsewhere. Case material is being gathered in several European countries, for example, by the Royal Swedish Academy of Engineering Sciences in collaboration with S.N.S.(Studieförbundet Näringsliv och Samhälle), and in Britain by P.E.P.(Political and Economic Planning); but these case studies are concentrated more on questions of managerial economics and planning.

Case-Material on Employment, Wages and Hours of Work

Published information on the labour-saving potentialities of automatic equipment, of which there is a fair amount, usually takes the form of a statement that whereas x workers were formerly required for a process, automation has reduced requirements by y per cent—sometimes percentages alone may be given [12, p. 72]. These statements are now sufficiently numerous for one to accept the fact that automation, in its various forms, has a high labour-saving factor. But they tell us nothing about the effect of automation on employment, for they usually ignore the impact on indirect labour (see page 76), and rarely say whether lay-offs have or have not taken place. The fullest analysis of the available case-material, and more especially of the small amount relating to lay-offs, has been carried out by Cass. His broad conclusion is that the laying-off of labour due to automation depends entirely on the state of demand in the industries or firms introducing automation, and that in most cases demand has been sufficiently buoyant for absorption of displaced labour to take place [4].

1. The following seemingly relevant studies are known to be in progress: George Schultz (M.I.T.)—Impact of automation, particularly labour force implications; National Planning Association (Special Policy Committee)—Industrial economic and social implications, covering rate of development and effects on productivity, employment and labour relations; Harold Lunde (University of Minnesota)—Effects on employment, productivity, wages and occupational structures of firms; Lee M. Silverstein (University of Connecticut)—Present status of automation in Connecticut industries and its future implications for industry and labour; Doyle D. Bishop (Ohio State University)—A study of the effects of automation in a selected industry. Past studies of the U.S. Bureau of Labor Statistics should also not be forgotten: the Bureau, both immediately after its formation in 1885 and repeatedly up to 1939 made studies of changes in labour productivity, especially those resulting from mechanization.

This conclusion is confirmed by the three detailed case studies of the U.S. Bureau of Labor Statistics in a large mechanized bakery, an electronic equipment plant, and an insurance company installing an electronic computer [20, 21, 22] and by the Liverpool University (U.K.) study of a steel firm [15, pp. 42-6].

This evidence is encouraging, but any conclusions must be heavily qualified. We do not know the extent to which automation is likely to be introduced in industries or firms where demand is static or falling, or in industries where fluctuating demand is characteristic, or where there is a geographically concentrated labour force. Any one of these factors could lead to results different from those in the firms so far studied. In fact, as we suggest later, there is a limit to what one can learn from case studies of individual firms.

There is even less evidence of the effect of automation on wages. What there is (mainly in the cases studies of the U.S. Bureau of Labor Statistics referred to above) suggests an expected result: that the higher efficiency of automatic processes leads to wages which compare favourably with those on comparable non-automatic processes. But clearly this will depend on the bargaining situation in different countries, industries and firms, and no general conclusion is justified. What can be said with some certainty is that wage structures are likely to undergo considerable strain when the plant or process with high productivity due to automation exists alongside those with strikingly lower efficiencies. If the ability to pay of the firms with automation is exploited, higher rates of pay will result than the rest of the industry can stand, and an unstable bargaining situation will result. Further, workers on automatic processes in an individual firm may be able to press demands which drastically alter their position relative to other groups in the same plant; this would be especially likely if piece-work incentives, based on the assumption that the individual operative can influence output, are carried over to automatic processes in which the rate of output is entirely governed by technical factors. A detailed study of problems of this nature, in a particular industrial sector, has been completed by Slaiman of the University College of South Wales (U.K.).

On working hours, very little reliable case-material has come to light. A prediction by Seligman [16] for the U.S.A., based on the assumption that productivity will continue to increase at an average of 2 or 3 per cent per year, and that the present 3: 2 share-out between increased leisure and increased earnings will be maintained, suggests a 32-hour week for the whole non-farm economy in 25 years. This is obviously a long-term matter. In fact, it does seem that a more immediate effect of automation will be to change the pattern of working hours in the direction of more widespread shift-working, rather than a striking reduction of the number of hours worked per week. Shift-working may, for example, spread to the office sector [28, p. 38][1] with the introduction of electric computers.

Level of Impact

Uncertainty and concern about the effect of automation on employment and working conditions has had the inevitable result that the initial emphasis in research has been on fact-gathering in individual firms. From this case-mate-

1. See page 79 for references to research into the social effects of shift-working.

rial, referred to above, one can hazard the conclusion that, given sensible personnel policies and favourable market conditions, most firms can manage the introduction of automation without any very great labour repercussions.

One important drawback of the case-study approach is that it gives little idea of the general picture. It answers the questions as they pose themselves to an individual management, but not for institutions with a broader responsibility. A second approach has been to analyse national productivity statistics to see whether, on the basis of known trends, productivity is likely to increase at an unaccustomed pace. The results of such analysis for the U.S.A. lead to the broad conclusion that productivity growth is not greatly faster than in the past, and that in any case past experience shows that productivity increase is accompanied by shifts in employment between sectors and not a net decline in employment [24, pp. 12-14].

This picture—based on the above approaches—is very incomplete. It is perfectly possible for any labour displaced to be absorbed within the individual firm, by expansion of output at the expense of competitors or by restriction of normal recruitment; yet total employment in the industry may decline in consequence. It is also possible for a general productivity increase to conceal rapid changes on the narrower front of particular sectors of industry. Indeed, one would expect the adjustment to automation to come in shifts between the relative position of different products, industries, and forms of employment, rather than at the level of the individual firm or the economy as a whole. Further, the two above approaches tell us practically nothing about the most crucial question, the likely rate of technological change. Two things need to be known before valid predictions of the rate of technological change are possible: the developments in automatic production technique likely to improve operations; the marketing, capital and other economic factors which will govern the rate at which they will be introduced. These technical and marketing factors can best be stated in respect of a whole industry.

There seems in consequence to be a serious weakness in current research into the social effects of productivity increase. Only at the U.S. Bureau of Labor Statistics are industry or sector studies envisaged; one on the electronic computer field has been started [28, pp. 83-7]. It is true that there have been some attempts to construct economic models to trace out the effect of different rates of productivity increase in individual industries both on related sectors of industry and on competing industries in other countries [17]. But these attempts have not got beyond the stage of problem formulation. The reason for the dearth of detailed analyses by industry of future productivity growth and its likely consequences are perhaps not difficult to see. Although a variety of industry studies are possible, their greatest use would be if they could throw some light on the crucial question of the speed and extent of change. To do this involves judgement of the technological paths open to an industry, of the economic factors which would influence the choice between them, and of the marketing conditions likely to affect the rate of development. This would require a level of combined technical and economic analysis not likely to be found in more than a few existing research institutions.

THE HUMAN/TECHNICAL EQUATION

Productivity increase, including its social effects, is basically an economic phenomenon. These effects are not peculiar to automation; they cannot be understood—let alone predicted—unless there is a better understanding of how the economic system works. There is, however, a second and distinct set of effects: the skills, satisfactions and organizational structures that automation brings in its train. Even though the importance to society of these effects will depend on the extent to which automation spreads, they can be identified and examined here and now in the individual plants using automation.

The notion that any technical innovation in the means of production brings with it associated human phenomena—a human side to the technical equation—is certainly not new. Georges Friedmann in particular has done much to elucidate the human problems of industrial mechanization, ranging from the physiological effects of repetitive work to questions of skill, satisfaction and the use of leisure. His work provides an excellent springboard for the analysis of the human implications of automation.

A somewhat new approach to the exploration of the human/technical equation is to be found in the recent work of the Tavistock Institute. The Institute has propounded the idea that the technical methods of production and the human organization for using them interact in a systematic manner and that the 'socio-technical system' can be analysed into its components and rebuilt into a more effectively functioning whole [27]. The potential value of this approach is that it gets away from the view that the human effects are the inexorable consequences of the technology, and postulates an area of freedom in which mutual adjustment can take place.

Research explorations of the human/technical equation of automation, in its different aspects, are discussed below.

Skills and Occupational Structure

A radical transformation of skills and occupational structure due to automation has been predicted by many observers. This potential result is welcomed by some as heralding the banishment of occupations unworthy of man. But those affected are more likely to fear that automation will render obsolete their skills as well as their machines. This anxiety about the obsolescence of skills is probably more profound than other reasons for resistance, even the fear of unemployment.

The first question to be answered is whether skills at the operative level in industry are transformed by automation to a degree where the retraining called for is uneconomic to managements, and beyond possibility for rank-and-file workers. In a preliminary survey by the Department of Scientific and Industrial Research (U.K.) [7, pp. 66-75], the evidence from four firms using transfer machines, automatic looms, a continuous strip mill (steel) and an advanced petroleum-refining plant suggests that a moderate amount of training on the job—certainly not more than the practice of progressive modern firms would provide—will suffice. Professor J. R. Bright of Harvard University, following a preliminary survey of firms using different forms of automatic production equipment, has come to the conclusion that in general less operative skill and training is required than formerly [2, p. 32]. The evidence begins

to suggest that, as far as operative skills are concerned, there is a diversity of effect which parallels that of the techniques themselves: in engineering, a modest degree of upgrading due to increased responsibility rather than the occupational skills involved; in the process industries especially, the substitution of automatic sensing devices for subjective judgement based on craft knowledge leads to the obsolescence of the manual and perceptual techniques acquired by operatives; with the introduction of the electronic digital computer for clerical work, an operating team very different in skill from the clerical group is displaced, but drawn from that group to a greater extent than would be expected.

The ingredients as well as the level of operative skill may of course be changed by automation. The automatic plant is to be manned, so we are often told, by overalled monitors with spotless hands but eyes wearied by the constant observation of dials and gauges. Perceptual skill and fatigue will replace physical fatigue and manual skill.

There can be little doubt that, with the growth of instrumentation, operatives are being increasingly called upon to act on visual and auditory signals; the results of ergonomics research pertaining to the proper design of visual displays and the presentation of other types of signal are of growing industrial significance (the results of much of this work have been digested [10]). There is some evidence, however, that perceptual skill and fatigue may be more typical on semi-automatic machines, and that on fully automatic processes the accent shifts to 'conceptual' skill, that is to say the ability to perform a function based on understanding of the process and of one's role in relation to that of others. A case study carried out by Whyte in a petroleum plant provides evidence in this direction [26, pp. 4, 7, 10]. Touraine, in probably the first detailed study of the effect of changes in the techniques of production on skills and occupational structure (at the Renault Company, France), puts forward a related hypothesis: that the stage of industrial development brought about by the introduction of automatic processes is typified by radical change in the status of the operative, in which the social characteristics of the task take precedence over occupational skill [18, p. 123].

Obviously we are still in the dark. The first necessary step, it would seem, is a survey of skills on typical automatic processes in order to pin-point the direction of any significant changes, and to relate these to existing research findings. Such a survey is at present being undertaken under the direction of A. T. Welford of the Psychological Laboratory, University of Cambridge.

Whatever the true picture of the impact on operative skills, it can only provide a partial answer to the practical problem. For it is entirely possible for the operative skills to retain their existing character, and at the same time for the over-all occupational structures of the individual plants affected to be transformed. In fact, undue concentration on the operative skills rather than on the whole occupational structure is likely to lead up a blind alley. For the effect of automation on the relative numbers of operatives to other categories such as maintenance and management appears to be more significant than the changes required in operative skill. This point is strikingly illustrated by the findings of Scott and his colleagues (Liverpool University): in the steel mill studied by them the production line operative needed less craft experience following the introduction of a continuous strip mill [7, p. 68]; but the proportion of craftsmen attached to the sheet-making processes rose from 4 to 10 per cent because of increased maintenance needs [15, p. 45]; and the

proportion of managers, supervisors, clerical workers and technicians rose from 10 to 14 per cent [7, p. 67]. A comparative study of steel mills in Germany and the United States with different levels of technical development has led Harbison (Princeton University) to the general conclusion, which supports the Liverpool findings that 'there may be a direct and positive relationship between investment in technology and investment in organization' [12, p. 371].

These shifts in occupational structure in the firm, away from strictly manual skills to occupations involving varying mixtures of technical knowledge and conceptual ability, pin-point a very considerable gap in current research in the psychological and related fields. Considerable research effort has been put into understanding the nature of manual skills and the process by which they are acquired. The abilities and training needed in occupations such as maintenance, design, research and work study have hardly been touched upon. It is therefore of considerable interest to note that the Medical Research Council's Applied Psychology Research Unit at Cambridge (U.K.), well known for its contributions to knowledge of manual skill, is at present studying the skills involved in the location of faults in electronic and other systems. Much more work of this type appears to be needed.

Even if there were clear evidence on the changes automation brings in operative skills and the occupational structure of individual plants, it would not entitle us to draw any broad sociological conclusions. To do that we would need to know the scope of automation and how fast it will come. This is precisely what we do not know at the present time. Further, it is entirely possible, indeed likely, that traditional forms of mechanization and mass production will continue to spread (for example in agriculture and mining), even as some territory is surrendered to automation; there are therefore likely to be countercurrents in the effect on skills and occupations in the total population.

Georges Friedmann, in his recent book *Le Travail en Miettes* [9], justly castigates those starry-eyed prophets who foresee the disappearance of all burdensome jobs due to automation. An appendix on 'The Proportion of Unskilled and Semi-skilled Workers and Craftsmen in the Working Population' is the best available analysis of the trends shown by existing statistical data from a number of countries [9, pp. 265-308].

Satisfaction

Temptation is great, when pondering the human effect of a giant stride in technology, such as automation, to assume a similarly dramatic change in the human aspects of work. But for all reasonable working purposes we must assume that human nature will remain as before; and therefore that what little we already know about satisfaction, even though it related to existing forms of production, is an essential even if modest starting point.

The first question to be looked at is whether the immediate job characteristics are likely to change. Under repetitive mass production, the man/machine relationship has certain typical characteristics: mechanical control of working paces, repetitive work, low skill, remoteness from the function and the purpose of the product, absence of intrinsic interest in the job. Research seems to suggest that the machine-imposed working pace is a key cause of dissatisfaction. Walker and Guest, in their study *The Man on the Assembly Line*, observe: 'the mass production characteristic disliked most by a majority of workers in our sample was mechanized pacing' [23]. This conclusion is supported to some

extent by recent work of the National Institute of Industrial Psychology (U.K.) into the organization of repetitive tasks [5, p. 26], and by Welford's experiments at Cambridge which point to the importance of time-stress or speed-stress for older workers [24, pp. 144-5, 148]. One possible solution to this uneasy alliance between man and machine is so to reduce the work cycle and adapt the speed of production that the operator can work as an automaton. While such a solution may appear to have been indicated by early psychological studies which stressed the need to remove the attention-claiming characteristics of repetitive work, later research suggests that such a solution is neither physiologically or psychologically viable (see *Le Travail en Miettes* [9] for a full treatment of this question). A second possible solution lies in the fully automatic machine: the human operator is no longer an ancillary x to be written into the machine equation, but an onlooker or supervisor of the process. The empirical evidence for the disappearance of pacing on fully automatic processes is, it must be admitted, slight (the case of an oil refinery has been cited [7, p. 72], but it would seem to follow from the principle of automatic control itself. However, it should be emphasized that many so-called automatic machines are really *semi-automatic* machines with a high rate of output, and in these the problem of pacing may be at its most severe.

Although pacing is of central importance, other important questions concerning the immediate characteristics of the job do arise. What for example are the consequences of loss of physical activity? Is speedy intelligent action in emergencies compatible with long periods of inactive monitoring? Does the interdependence of tasks lead to the greater satisfaction of knowing more of the purpose of production, or to tension due to the absence of self-contained and limited roles? All these are unanswered questions.

We have also to consider the question of social satisfactions. The decline of craft satisfaction and skill under repetitive mass production has led to a compensating emphasis on 'human relations'. How is the factory as a social system affected by automation? The characteristic image of the mass production workshop is the group of repetitive workers in close physical proximity, deriving social satisfaction from banter and informal groupings. In the automatic plant, the typical picture becomes a thin spread of workers over a large floor-space, the individual operative often being physically isolated amongst a mass of machinery. There are however important exceptions; for example the study by Mann and Hoffman of two power plants, one highly automatic and one of older design, revealed a reduction of physical isolation in the more automatic plant, due to the centralization of the control system [28, p. 61]. In any case, it seems possible that changes in what management requires of the operative, resulting in different social relationships of a functional kind, will be much more important than simple physical isolation. The machine-minder or monitor on automatic processes has to take intelligent and quick action in the event of break-down or emergencies, to co-operate with maintenance in the detection of faults and the prevention of down-time. He is much more the agent of management than the object of management technique and discipline. For he no longer controls output, and is therefore not the most logical focus of management efficiency techniques. Instead of the group of repetitive workers 'man-managed' by a foreman, automation may lead to a more satisfying working group based on the task interdependence of machine-minder, maintenance technician and supervising engineer.

Nor can the question of satisfaction be discussed solely in terms of job-

characteristics and the factory as a social system. The prospect of increased leisure due to automation has already put wind in the sails of those who take it as read that modern factory work cannot satisfy and enrich the human individual; the good life is to be sought in the boundless leisure made possible by more efficient machines. But the reduction of the working day from 8 hours to 6 hours—even this is an assumption for the future—can hardly be expected to work a miracle. However, the change in the pattern of working hours and leisure due to shift-work, often necessary because of the economics of automatic plant, raises more realistic questions. In the study of the power plants referred to above, the conclusion is reached that the effect of shift-working on workers' lives is 'negative' [28, p. 64]. The social effects of shift-working have also been studied in the United Kingdom by the Department of Economics, University of Sheffield, the Psychological Laboratory, University of Cambridge (in a rayon plant), and the Department of Social Sciences, Liverpool University (a steel plant). Some preliminary results of the Liverpool study suggest that the adaptation of domestic routines does not present serious difficulty, whereas the loss of the week-end for family social activities is a great loss [15, pp. 224-9]. These social changes due to the introduction of shift-work are part and parcel of wider community changes, ranging from new leisure pursuits to radical differences in the way the family budget is spent. A detailed study of such community effects of technological change (including automation) in South Wales is in progress under Professor Fogarty at the University College of South Wales, Cardiff. As yet we know little of these effects of the highly efficient plant or industry. Yet they cannot be divorced from questions of work satisfaction, for experience shows that the worker will readily write off satisfactions as a producer against his possibilities as a consumer.

As far as satisfactions are concerned, at the present time we can only guess at the right questions, and we certainly cannot provide the answers. What is clearly needed is a study on 'The Man on the Automatic Line' similar to Walker and Guest's study *The Man on the Assembly Line*; this would enable some sort of perspective to be established. It is to be hoped that such a study will follow the introduction of automation at the Ford Cleveland plant more quickly than the Walker and Guest study followed the introduction of the original Ford assembly line! We need also to realize that, if we know little of the satisfactions of the 'man on the line', we know even less of the satisfactions in maintenance work, in production planning and work study, in research, and in the many other categories of occupation likely to increase in importance with the spread of automatic methods.

Management Organization and Group Structure

Theories of management structure and organization owe little to systematic empirical research. Practitioners such as management consultants have built up a body of knowledge based on their field experience. Social research workers, thinking more in psychological terms, have stressed group attitudes rather than organizational principles, and have been interested in the informal rather than in the formal aspects of organization. These two approaches have developed more or less independently, if not with a degree of mutual disdain. There are however signs of a ***rapprochement***: the sharp effects of changes in technology on management and group structure challenge equally the tenets of the practitioners and academic generalizations about group behaviour. This trend,

which is to be seen in the research discussed below, is not of course peculiar to automation. However it is the aspect of thinking and research on management organization most relevant to the problems of automatic production.

The first noteworthy point is that, when introduced, automation and other technological changes can bring about a great disturbance to the management system of the firm. There is now a great deal of anecdotal evidence of this; typical in the case of vice-presidents who, when the introduction of an electric computer was planned, 'feared that the computer would take over the functions of their particular departments and thus remove much of their prestige, if not their rank' [28, p. 82]. Ronken and Lawrence's (Harvard) study of the introduction of the 'Amicon tube' (an electronic gadget) traces the uncertain course of a technical innovation caught up in inter-departmental rivalries and misunderstandings, to the point where the departments concerned seem to spend more energy in finding ammunition for inter-departmental clashes than attaining the objective set by the firm [15]. Craig (Harvard) has carried out a similar study of a firm's conversion to electronic accounting [7].

The fact that technical innovation brings organizational disturbance with it can, on the basis of such evidence, be taken as read. But the speculative literature on automation goes a good deal further: among other things it is claimed that automation 'means organizational flexibility'; 'makes management team-work a must', 'undermines the line-and-staff principle', and so on. In other words, there is a pattern of organization—different from that previously to be recommended—which is called for in firms using automatic processes. This is an important issue; for in the past there has been a tendency to think of principles of administration which are proper for any type of production. A research project to examine the validity of this approach in firms with very different production systems (batch production, flow production, mass production of discrete units, etc.) has been carried out by Miss Joan Woodward of South East Essex Technical College (U.K.); on the evidence of some 100 manufacturing firms surveyed it seems that the different production systems present characteristic situational demands, and that these demands are successfully met by different organizational and structural expedients. Burns of Edinburgh University (U.K.) has independently reported findings which strike a similar note [3]. As a result of a study of firms entering a new production field he has postulated two 'pure types' of organization: the 'command' type appropriate to stable situations and the 'collaborative' type more suitable in conditions of rapid change. The 'command' organization is typified by rigid definition of function and status, whereas the 'collaborative' type keeps the situation unfrozen and can then adapt itself to new requirements. In his Renault study, Touraine suggests that there are certain organizational features typical of the automatic stage of production as such: in particular the reintegration of the office and production functions which, under 'Taylorized' mass production, have become increasingly estranged. All these studies seem to point in a single direction: towards a closer link between the theories of management structure and organization and the changing technological environment in which management operates.

The above studies are mainly sociological in character. A similar trend in some social psychology research can be noted and in particular in the industrial studies of the Tavistock Institute of Human Relations (U.K.). The interplay of the production functions required by a given technical system and the social roles and groups required to achieve them was first of all studied by Trist

and Bamforth in the coal industry [19], and later by Rice in automatic weaving [13]. A similar study of automatic weaving in a synthetic fibre plant has been completed by Fensham at the Psychological Laboratory, University of Cambridge [8]. This approach to group studies, starting as it does from a detailed analysis of the requirements of the technical system, promises to bring the analysis of factory social groups on to a more concrete basis. For it seems to imply—and this is something which will no doubt appeal to the industrial manager— that socially effective working teams depend as much on a proper division of functions and tasks, as on more intangible factors such as psychological affinity. Furthermore, the detailed analysis of task requirements gives the social psychologist some common ground with the production planning expert; this will enhance the possibility of getting social and psychological considerations taken into account in the technical planning of production.

The research reported in this section does not clearly show whether or not there is a form of management organization and group structure particularly appropriate to automatic production. But it certainly does suggest that accepted notions must be critically examined, and that success may be best achieved by forms different from those used in other types of production.

CONCLUSION

An Opportunity for the Social Scientist

The development of public interest in the social impact of automation presents the social scientist with a real opportunity to make a contribution to public policy. For there can be no doubt that public authorities and industrial organizations in many countries would welcome factual evidence on matters which to date have been a fertile field for speculation. Out of the flood of words two broad attitudes to the effect of automation seem to emerge: the one sees the Machine treading down Man; the other sees automation rushing us towards a kind of Utopia in which material goods and moral blessings will abound. Neither view is supported by the available evidence. The task which falls to the social scientist is this: to produce the evidence to show how a sensible course can be steered which, while allowing full use of these techniques, avoids the social pitfalls that have accompanied previous big advances in the techniques of production.

Can we reasonably expect the social sciences to rise to the occasion? Some circumstances are favourable. First, there is no need to start from scratch. As we have seen, for some problems the knowledge of the effects of repetitive mass production provides a good jumping-off point; other problems are common to all technological change. A first important task is to distil out of existing knowledge and data that which is relevant to the new problems. The second favourable circumstance is that the immediate task of assessing, documenting and analysing existing cases of automation should not be beyond the available research techniques. Finally, the present marked manifestation of public interest means that the resources required for the research are likely to be available.

But what cannot be provided at short notice is trained research workers. Therein lies a real danger. Already, problems related to the social impact of technological change are claiming a considerable part of the very small corps of social research workers in Europe. It would not be an exaggeration to

say that in some countries all those competent to organize and carry out field studies in industry could turn to problems of automation without the effort being out of proportion to the importance of the problems.

In these circumstances it is vital that duplication of effort should be reduced to a minimum; and that the exploitation of existing knowledge should be pushed to the limit. It is to be hoped that the plans for study in different countries can at least be based on adequate exchange of information, and perhaps co-ordinated in some way. The pressure of scarce resources is leading to international collaboration in research in other fields. It is to be hoped that at the forthcoming Conference of the European Productivity Agency on the social and economic implications of automation, the opportunity will be seized to take the first steps in this direction as far as the study of the socia implications of automation in concerned.

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PROCEEDINGS OF THE CARNEGIE STUDY GROUP ON THE BASIC PRINCIPLES OF AUTOMATION

Geneva, 1957

Automation has been for some time a topical subject. Its possible consequences have been examined by social scientists as well as by business and trade union leaders. A number of United Nations Specialized Agencies are paying considerable attention to the implications of automation for their respective fields of action. In order to draw together some of the threads, the European Centre of the Carnegie Endowment for International Peace organized in Geneva during 1957 a study group which resulted in the preparation of this report. The Endowment was fortunate in obtaining the co-operation of specialists in various disciplines (economists, sociologists, psychologists, doctors and engineers), of members of the staff of several international agencies (ILO, WHO, ECE, GATT), as well as representatives of labour and management. All the members of the group served in their personal capacity.

The group was composed as follows: Mr. Hervey G. de Bivort (ILO), Dr. Donald Buckle (WHO), Mr. James Burtle (ILO), Mr. Jacques Chapuis (engineer), Mr. Eric Choisy (engineer), Mr. Paul Chu (ILO), Mr. Michel Cuenod (engineer), Mr. Douglas Deane (YMCA), Mr. Arthur Ewing (ECE), Mr. Roger Girod (Professor of Sociology,

University of Geneva), Mr. Karl S. Gruenberg (ILO), Mr. Michael Kaser (ECE), Dr. Eduardo Krapf (WHO), Mr. Charles Levinson (International Federation of Metal Workers), Dr. Renato Malan (WHO), Dr. Jerome S. Peterson (WHO), Mr. Hans A. Rhee (ILO), Mr. Hans Staehle (GATT), Dr. Michel Tchicaloff, M.D., Mr. Edward Thompson (ILO), Mr. Sam Udin (ILO). The Chairman was Mr. John Goormaghtigh, Director of the European Centre of the Carnegie Endowment.

The following persons attended some of the meetings as guests: Mr. Stéphane Bernard (Institut de Sociologie Solvay, Brussels), Dr. J. Parisot (Dean of the Medical School of Nancy), Dr. Jack Rees (World Federation for Mental Health), Dr. Kenneth Soddy (WHO Consultant).

Papers were read by: Mr. Eric Choisy (President of the European Federation of National Associations of Engineers) on 'The Technical Aspects of Automation'; Mr. Arthur F. Ewing (Director of the Steel, Engineering and Housing Section, ECE) on 'The Economic Aspects of Automation'; Mr. Hervey G. de Bivort (Industrial Committees Division, ILO) on 'The Social Aspects of Automation'; Mr. Joe Hoffer (International Conference of Social Work) on 'The Social Aspects of Automation'; Dr. Eduardo Krapf (Chief, Mental Health Section, WHO) on 'The Psychological Aspects of Automation'; Dr. Charles R. Walker (Director of Research in Technology and Industrial Relations at the Institute of Human Relations, Yale University) on 'Mental Health and Automation'; and Mr. Charles Levinson (Secretary of the International Metal Workers Federation) on 'Certain Effects of Automation on Collective Bargaining'.

Mr. James Burtle (ILO), who acted as secretary of the group, drafted the present report.

At its first meeting, the Study Group heard a scientific exposé of automation by Mr. Eric Choisy, a graduate engineer of the École Polytechnique of Lausanne and President of the European Federation of National Associations of Engineers.

Mr. Choisy believed that it was difficult to formulate a simple concise definition of automation. A better way to understand automation, he said, lay in a consideration of the principal forms in which its basic concepts are being applied. These are: (a) integration of processes for the automatic transfer of an unfinished product from one stage in production to another; (b) feedback control or self-correction of errors; and (c) the technology of computing machines.

INTEGRATION

This process may be viewed against the background of mechanization which developed so rapidly in the 1920s. Under mechanization, jobs formerly done by one often highly skilled worker were re-arranged to be done in many small operations performed by machines or by separate workers. Mechanization resulted in great increases in productivity, but at the same time the problem of the movement of material and semi-finished products between stages in production became more complicated than in the days when one skilled worker performed several operations. This problem led to the development in the 1920s of the chain belt or assembly line. From the assembly line with its chain of manual operators it was quite a natural step to the development of the transfer machine or assembly line between the various automatic machines.

This aspect of automation is often referred to as 'Detroit automation' since some of its most publicized applications have been made in the automobile industry in the United States. It represents ingenious rather than revolutionary applications of well-established mechanical methods for loading, unloading, transporting, and positioning identical parts by means of a series of separate but closely integrated machines.

FEED-BACK CONTROL

No process of manufacture, transfer and assembly of parts will ever work perfectly without periodic adjustment or correction by either human, mechanical or electrical means. Such tools as grinding wheels or cutting dies for example will change in dimensions simply as a result of the wear and tear of constant use. If the product is to be kept uniform, some adjustment will have to be made in the shape or position of the tool to counteract such changes. The raw materials on which the tools work are likewise not always completely uniform in character, and adjustments may have to be made to allow for this. In the iron and steel industry for example, every batch of iron ore is likely to contain somewhat different combinations of impurities which must be removed by properly adjusted production methods. On the integrated line discussed above, products may sometimes move too rapidly or too slowly, so that one machine will be 'waiting' for more unfinished parts while another machine may be overloaded with more parts than it can efficiently deal with.

Feed-back is the process by which these and numerous other types of errors that inevitably occur in production operations may be automatically corrected. It may be described as the control of the operation of a system in accordance with pre-established standards, by re-introducing the results of its action back into the system in order to correct departures from this standard. If a production system begins to produce an error or to malfunction, the error itself creates a signal to readjust the machine or the raw materials in such a way as to correct the error. There are numerous examples which may serve to illustrate this principle:

1. The flyball governor of a steam engine. This consists of two independent balls each hanging freely from the end of a short rod, the other ends of the two rods being connected to a collar which is free to slide up and down a vertical shaft while being rotated by the shaft's motion. The shaft is driven by the engine and its speed varies with that of the engine. As the engine speeds up, the balls tend to fly apart and upward, while any slowing of the engine permits the balls to swing inward and downward. This motion of the balls is in turn transmitted to a link mechanism which controls the throttle valve of the main steam intake of the engine. As the balls go higher, the valve closes and the engine slows down. As they drop below their normal position, the throttle valve will open and the engine will speed up.
2. The manufacture of sheet metal. This is a process which must be performed rapidly in order to prevent the premature cooling of the metal that is being rolled. Instruments have been developed which measure the thickness of the sheet and 'feed back' instruction to the cylinders to ensure that they squeeze the metal to the desired thickness. If the sheets tend to be too thick, a feed-back signal is sent to the cylinders to squeeze the metal more. If the sheets are too thin, a signal is sent back to squeeze the metal less.

This process has made it possible in one French steel mill, for instance, to run steel sheet through the final set of rollers at a speed of 80 km. per hour while maintaining the desired standard of thickness within extremely narrow limits.

3. The *concept* of feed-back has also its applications in the medical field. The idea of the cyberneticians was to show that a parallel exists between the functioning of machines and the functioning of the human body as there are in fact a great number of feed-back processes involved in normal bodily functions. For example, the level of glucose in the blood is regulated by the principle of feed-back. If there is too much or too little glucose in the blood, certain organs react to produce less or more. The same principle applies to the regulation of arterial pressure. If this pressure rises, it stimulates certain nerves which affect the heart and the dilation of the arteries. The resultant reaction of the heart and arteries then offsets the rise in blood pressure. These examples from physiology illustrate the principle of feed-back, since in each case the results of an action are introduced back into the system.

In many cases of course, feed-back in industrial processes works with a human agent. A technician watches a control board for a signal of an error and then adjusts the production process to correct the error. The development of vacuum tubes and electronics has made it possible, however, for an increasing number of processes for sending and reacting to signals to be done automatically without requiring human intervention. One advantage of electronic control is its simplicity in comparison with mechanical methods. As was suggested above the governor on a steam engine is a reasonably efficient method of mechanical feed-back. On more complicated machines, however, mechanical feed-back might require involved machinery—perhaps a train of gears—whereas electronic control can be effected with little more equipment than a few vacuum tubes. This is one reason why, in practice, electronics often plays an extremely important part in the more developed forms of automation.

COMPUTER TECHNOLOGY

In any discussion on this subject the term 'electronic brain' immediately comes to mind, although, of course, this term should not be taken too literally since no mechanism is as complicated as the human brain. The three basic considerations in the construction of 'electronic brains' are the following:

1. They should react to measurable quantities in somewhat the same way as a human brain or a feed-back control reacts to different levels of stimulus. For example, in a factory with two departments making two different products, a fire in one department could be extinguished by a carbonic anhydride and in the other by water under pressure. We can imagine a fire control system which could, according to the departments involved, detect dangerous levels of temperature and put into action the proper fire control apparatus. This is a particular illustration of the general principle of thermostatic control.
2. They should have sufficient energy available to undertake long computations that it would be difficult for the human brain to perform without fatigue.
3. The machine employs electronic tubes as in radio sets. The introduction

of electronics into the construction of calculating machines has thus practically eliminated considerations of time in getting a result from the machine, since electrical signals travel through the machine at a rate of about 300,000 km. per second.

Although modern electronic calculating machines are based on an invention by Abraham in 1926, perhaps a more basic contribution to this field was made in 1936 by the French scientist Louis Couffignal. He suggested that the binary number system might be better suited to the workings of computers. This system, although discovered by the ancients and used by Leibniz, was, until Couffignal's work appeared, regarded as no more then a scientific curiosity. In the binary system, numerical notation is based on a radix of 2 instead of 10. We thus have 1, 10, 11, 100, 101, 110, 111, 1,000 1,001, 1,010, 1,011, 1,100, 1,101, 1,110, 1,111, 10,000 instead of 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16. While a system that uses such a long number as 10,000 for such a short number as 16 would be clumsy for the human brain to use, it is ideal for the electronic calculator. The human brain can easily handle small numbers with diverse symbols: i.e., small numbers involving the digits 0 to 9, but it suffers from fatigue in handling long numbers. An electronic machine, on the other hand, since its supply of energy is very great, does not suffer from fatigue and can easily handle long numbers. It does, however, lack versatility and cannot easily manage number systems with more digits than 1 and 0. With a binary number system it is easy to put any number into the electronic machine by letting an impulse equal 1 and no impulse equal 0. So for a machine the binary number system is simpler, more rapid and more economical than the decimal number system, even though a translator mechanism is required to change numbers from the decimal to the binary system at the beginning of the process and from the binary back to the decimal system at the end.

Operations with the binary system may be compared to logical reasoning with a series of alternatives—each decision can be compared to the choice between 0 and 1 (i.e., 'yes' and 'no', 'go' and 'do not go'). Machines are also comparable to the human memory because they can store information and find it again. But they are not comparable to the human brain in other respects: a machine has less than 20,000 cells while the human brain has 8 to 10 billion; furthermore, the machine, unlike the human brain, has no creative imagination.

The contribution of computers to scientific research is well known and need not be treated in detail here. Many problems that formerly could not be solved, or would have required many months of computations with desk calculators, can now be solved rapidly. In effect, hitherto practically unavailable information is now readily available to the scientists.

What the Study Group was particularly interested in, however, was the role of computer technology in automation. The capacities of computing machines for organizing information, problem-solving and artificial memory can all be profitably used in many automated processes. Without computer technology the feed-back aspect of automation would often be impossible. The need for computers in many feed-back processes arises because a number of different signals calling for the correction or adjustment of a machine may be received simultaneously. These signals have to be co-ordinated before the machine can be adjusted.

The data indicating the need for adjustments in a machine must first be

'processed', i.e., sums, differences, products or more complicated sets of figures must be computed, and to be effective such computations must be made rapidly. Sometimes processing of data is enough to enable the feed-back to be completed. In other cases, however, the processed data may indicate that several signals must be co-ordinated in such a way as to strike a balance between them or to call for some other form of mathematical solution. Such problems may be almost impossible for the human brain to solve. In many cases, however, a machine can solve them and put the solution into a completed feed-back process.

The memory function of these machines is also important in automation, since it would be wasteful to wait for a machine to solve the same problems over and over again. The memory function of the machine makes it possible to obviate this waste of time since the solutions or data required to deal immediately with errors, correction, control, or adjustment problems that arise over and over again, can be 'stored' ready to be introduced into the feed-back system at the right moment.

It is then in its function as an organizer and 'unscrambler' of diverse and sometimes contradictory signals for feed-back that the computing machine becomes one of the main elements in many automated processes.

THE 'GENERALITY' OF AUTOMATION

Automation is thus a process by which unfinished products are moved from one stage to another, and corrections or adjustments to the products made in response to signals or feed-back at various stages in the process. Diverse, complicated or even contradictory signals may need to be recorded, co-ordinated or analysed and may even require the solution of mathematical problems before some feed-back processes can be completed. This operation may necessitate the use of computing machines.

Mr. Choisy placed great stress on the fact that none of these aspects of automation was ever developed to such an extent as to exclude the human element from production processes—'the automatic factory is a myth'. In the discussion in the Study Group there was agreement on this point and, although a considerable number of examples of advanced automation were presented, no case could be found in which workers had been completely replaced by machines.

The main concern of the Study Group was to examine the consequences of automation rather than to find particular examples in industry where it is applied. It was, however, generally agreed that there is an urgent need for more case studies of the application of automation.

In its study of various practical aspects of the subject, the group was perhaps most impressed by the effects of automation on clerical work. As Mr. Choisy pointed out, automation in offices began with the introduction of Hollerith punch card systems. These systems have been superseded by magnetic tape systems that can register as many as 20,000 symbols per second, thus permitting an enormous number of computations per minute. Modern computing machines can perform a great number of operations, including the preparation of pay-rolls, the clearing of cheques, and the calculation of material requirements for assembly lines. The General Electrical Company, for example, has a machine that prepares a pay-roll for 12,000 workers in two hours on a magnetic

ribbon; and only four more hours are required to prepare individual cheques and pay-roll statistics—a process that formerly required a whole week's work. The Bank of America has a machine that can clear 32,000 cheques, establish a daily bank statement, calculate bank charges and reject cheques on overdrawn accounts. In many factories the machine computation of material requirements makes the control of stocks of raw material easier and more economical.

Mr. Ewing of the United Nations Economic Commission for Europe noted that in England, LEO, the computing machine of the Lyons chain of tea-shops, calculates the pay-roll for some 10,000 employees in about four hours, whereas previously, with orthodox office machinery, some 37 full-time clerks were required. LEO also deals with the daily orders to the bakers from some 150 Lyons tea-shops and prepares all the data and records relating to production, assembly, packing, despatch, cost accounting, etc. Data are received by telephone at 3.30 p.m. and the job is completed by 4.45 p.m. In addition, LEO takes on a good deal of contract work for outside companies. A much-improved LEO is now available capable of doing the work of some 200 clerks in the space normally required by 30. The cost is about £75,000 but the resultant savings are expected to amount to at least £80,000 a year when the machine is fully employed on a 40-hour week.

Speaking of the so-called Detroit type of automation, Mr. Charles Levinson, Secretary of the International Metal Workers Federation, called attention to the reference made by the Director-General of ILO to the Ford Engine Plant at Cleveland. What had happened in this plant provided, in Mr. Levinson's opinion, a particularly good example of the speed of current developments in automation. The automation equipment at Cleveland was installed as recently as 1951, at a cost of over thirty million dollars. Already, three-quarters of this equipment is being scrapped and is to be replaced by new equipment designed to do exactly the same work, i.e., producing engine blocks, but at a much lower labour-cost ratio. In one year's time, it is estimated, the amount of labour required will be 25 per cent lower than what was required three years ago to ensure the same output of engine blocks.

What is striking about automation, said Mr. Levinson, is not that it is a new combination of three already well-known techniques, but that it is a development with extraordinarily wide possibilities of application. It is true, he continued, that particular aspects of automation can be traced back for many years. Transfer lines have been used in big factories for ten or twelve years now. Specific uses of feed-back control, and particularly of open-loop control mechanisms, have also been inherent in certain types of modern equipment for some time. But these instances have been confined to particular types of equipment and to particular processes in, for example, the petroleum industry or the automobile industry. The situation today differs in that this formerly piecemeal technique has now become one that is almost universally applicable in industry and commerce. It is this new universality of automation which gives it its real revolutionary character, concluded Mr. Levinson. Never before, he said, had there been a case in the history of technology where a technique with such vast ramifications had become available for use in factories of almost any size and in industries of any nature.

This idea of the general applicability of automation is in one sense in accord with the view of many experts on automation—that it is a philosophy or 'way of looking at things' rather than a new invention. Even if a production

process used no machines at all but did involve some specialization into different jobs, conceptually it could be looked at from the point of view of automation. In terms of each of these three aspects of automation one could assess the efficiency of the firm. Efficiency could be appraised in terms of integration, for the transport of unfinished products from one process to another, even though this process might be done by hand; in terms of feed-back control for the correction of errors, even though this process might consist in the inspector of final output telling the worker at a particular stage in the production process to make some change in his workmanship; and in terms of record keeping and problem solving, as a necessary element in the control process, even though this process might involve only old fashioned book-keeping. This idea of automation as a 'philosophy' has been of great practical importance: scientists working with the United Kingdom Department of Scientific and Industrial Research reported that when a firm is surveyed by engineers with an 'automation philosophy' they (the engineers) often do not recommend any new machinery; they may however suggest great improvements in efficiency by showing that sometimes because of the expansion of one of the elements of automation, an unbalance is introduced that makes other elements inefficient. A firm may have adopted integration but its feed-back system may not have developed sufficiently to correct enough of the errors in the expanded output resulting from integration; the feed-back system may be overdeveloped and capable of controlling more output than a weak integration system can produce; or again, the feed-back system may not work well because the computing system cannot work fast enough to supply it with the information it needs. Here the analysis is in terms of processes, not in terms of either men or machines, and it makes no formal difference whether or not consulting engineers surveying a plant actually recommend buying a new machine. Whether the recommendation involves changes affecting human operators or machines is secondary to the basic analysis of a particular process as being relatively efficient or inefficient.

This conceptual approach to production as a combination of processes, in contrast to the traditional economic approach, leads to the point made by Mr. Levinson: 'I think the current practice is to refer to the functional features of automation—integration, feed-back control and computer technology—and let that stand as a definition. I think, from a trade unionist's point of view, that's not sufficient at all because it doesn't set up the problem as such. It only refers to certain characteristics of the technique but it doesn't help explain what the effects of the technique are once applied to industry. I think most trade unionists would feel that the definition which is most satisfactory is that *automation is a technique or a process of production from which man is completely removed.*'

This argument may seem to be ill-founded since there are no automatic factories without workers. But it may be correct in that traditionally a production process has generally been considered to be a combination of labour and capital. Production problems concerned with men (industrial relations problems), and those concerned with machines (engineering problems), were considered separately. From the point of view of the expert on automation, however, production is a set of processes. Problems of men and machines are subordinate to the primary problem of securing proper balance and co-ordination between processes. In this sense man can be said to have been eliminated from the concept of the production process as a whole.

THE DIMENSIONS OF PROBLEMS RAISED BY AUTOMATION

As has so often been the case when a new approach is made to an old subject, this special 'automation' approach to production has brought to light a great many possibilities for improvement that were not evident so long as production was considered from the separate points of view of labour and of capital without an explicit break-down in terms of processes.

There was agreement in the Study Group that the development of automation was an important technical advance and that it would certainly raise a number of social problems. There was not agreement, however, on the extent to which automation might be considered a second industrial revolution.

Mr. Choisy showed, mainly on technical grounds, that automation did not involve much of a revolution. As early as 1800 the major elements of integration had been achieved in the Jacquard loom in the textile industry; as was noted above, the principle of feed-back has long been used in the automatic governor of a steam engine; and it is known that a calculating machine existed as far back as the seventeenth century. The continuation of these developments into automation, while doubtless an important step, was not nearly as important as the invention of the steam engine, the electric motor or electronics. In Mr. Choisy's view, it is electronics rather than automation that should be considered as revolutionary.

One might conclude, from Mr. Choisy's talk, that automation was not of revolutionary importance from the scientific point of view. From the economic and social point of view, however, it might be of great importance. Some inventions, of which the can-opener is a possible example, might have greater economic and social effects than other inventions representing much greater scientific genius.

One rough measure of the economic importance of automation is the extent to which it has been and is likely to be adopted. On this question a cautious viewpoint was taken by Mr. Staehle of the Economic Unit for the Secretariat of the General Agreement on Tariffs and Trade and by Mr. de Bivort of the International Labour Office. Mr. Staehle commented that: 'My most pronounced impression perhaps is that automation, so far from representing a "revolution" or from introducing a new area, has constituted, at least until now, nothing more than a new incident in the history of technological progress. It surely cannot yet, if ever, be compared to such innovations as the railways, the steam engine, or the application on a large scale of electric power, since the limited uses to which it can (at the present stage) be put, make it appear rather as belonging to the same category as machines for cigar-making or bottle-blowing. No doubt, it brings into play a number of new and different factors, especially in respect of mental health, education and human relations—though even here, I wonder if the questions which may be raised are strictly imputable to automation, as distinct from other kinds of technological advance, which, after all, continues, along with automation, on an extremely broad front.'

Mr. de Bivort called attention to the following points: (a) A University of Chicago study concluded that about 5 per cent of the labour force in the United States is likely to be affected by automation; (b) an American Society of Tool Engineers survey concluded that about 16 per cent of operations in metal working could be automated; and (c) private correspondence with the

editor of *Factory Management* indicated that this estimated 16 per cent automation would cost 7-10 billion dollars and in practice would require about 15 years for installation.

A somewhat less conservative line on the relative importance of automation was taken by Mr. Ewing, Dr. Krapf and Mr. Levinson. Mr. Ewing argued that results of questionnaires might underestimate the extent to which automation would be adopted because the over-all results of these studies were obtained by adding together results obtained from each individual plant on the basis of its own cost and market situation. Such questionnaire results might be considerably modified if other firms in the same industry began to adopt automation. Then there would be an increased stimulus to automation resulting from competition with already automated plants and also—though by no means least important—from the tendency for the large scale production of automated equipment to bring about really substantial reductions in the costs of such equipment. Mr. Ewing also believed that the spread of automation could be made more rapid if conscious efforts were made on a national and international level to overcome ignorance concerning its possibilities and to spread information about it. Mr. Kaser of the Economic Commission for Europe also suggested that the increased use of automation would make it more economic: 'As more and more automation takes place, you in effect have more and more trained technicians, more and more exchange between automation technicians, a growing literature on automation, cheaper common services on automation, in other words, automation consultants, in the same way that you have job-evaluation consultants and so on, and even technical services. You might have the Bell Telephone Co. build up co-axial cables between large centres of industry so that, as Mr. Choisy pointed out, the production flows in forty or fifty factories separated by hundreds of miles could be controlled from a unit centre. Here, there is a common service which could well be supplied by the same system as the telephone service.'

As was noted above, Mr. Levinson believed that the importance of automation lay in its generality of application. Even where a firm did not actually adopt the machinery of automation the new outlook associated with automation made it evident that sooner or later drastic changes were likely to be made in production processes. Within the frame of reference of automation, workers as well as management could see more readily that sooner or later a plant might require more integration, more feed-back control or better computing technology or perhaps that it would need to be rebuilt altogether or even re-located. This frame of reference might well make both management and labour automation-conscious long before automation itself was actually introduced. Automation might not affect a great number of workers in the aggregate, but because of the sporadic and localized way it has often been introduced, its effects have sometimes tended to arouse more interest than would have been the case had it been evenly distributed over a whole economy. That is, if automation affected only 5 per cent of the workers in all plants, it would not create the psychological problems that arise when it affects perhaps 50 per cent of the workers in a small number of plants.

This combination of (a) the potentially universal implications of automation and (b) its sporadic, but very noticeable, introduction in practice might have revolutionary effects. Workers and management in plants not affected by automation could see from the example of other plants, even in different industries, how they might be affected by similar adaptations in integration,

feed-back or computer technology. Finally, from a psychological point of view, this possibility of generalizing substantially different experiences may have quite different effects than had earlier inventions in glass-blowing and cigar-making, for example, even though the quantitative effects of improvements adopted in these industries might have been just as great as the quantitative effects of automation. As Mr. Levinson pointed out, trade unionists are anxious to be ready to deal with automation, before it becomes a problem. Such an attitude might not have been adopted had automation been a more narrowly specialized concept. The general applicability of automation may be the reason why, as Mr. Staehle suggested, 'it has been overwhelmingly successful as a slogan and has captured the imagination of the public at large'.

This imaginative impact of the notion of automation as being applicable to a wide range of activities is felt by management as well as labour. Turning from the perhaps rather narrow specialization of the mechanization movement of the 1920s, management is now tending to learn techniques from widely diverse types of production. The research director of the Ford Motor Company has complained that his engineers do not understand enough about techniques outside the automobile industry.[1] In the United States at any rate, many firms now 'diversify' in order to produce a much wider range of not always closely related products. Machinery firms are tending to manufacture equipment for a number of different industries. Consultants on automation are ready to recommend improvements in almost any production or organization process. Under these conditions, a development in one industry is likely to spread more rapidly to others. Such diffusion of technology would no doubt have taken place in any case but it may now take place more rapidly as industry adopts the 'way of looking at things' of automation.

Mr. Levinson's point that automation, because of its 'generality', was having a wide psychological impact, was given specific emphasis by Dr. Krapf of the World Health Organization. Automation, he said, might be relatively unimportant from a purely technical or economic point of view; what might be more important, however, was that automation aroused fears, anxieties and insecurities. From the sociological point of view, such fears and insecurities, even though they might be the result of exaggerated ideas about automation, constituted a real problem.

In the discussion following Dr. Krapf's talk, the point was made that it was perhaps one-sided to express the effects of automation only in terms of fear. Some stress should perhaps also be given to the element of 'hope' or, as some would say, of 'exaggerated optimism', with respect to rising incomes and productivity, created by automation. This point has particular validity when it comes to the analysis of the behaviour of management, especially as regards the making of decisions on whether or not to adopt automation. Moreover, most of the discussion in the Study Group centred around the effects of automation as a source of fears and anxieties.

The idea that automation is mainly a psychological phenomenon cannot be said, however, to make it a 'revolution' in any sense comparable to the first industrial revolution, unless it can be shown that automation is itself affected by the psychological conditions it creates. After all, the first industrial revolution was not just a change in the pattern of peoples' hopes, fears and other psychological manifestations. It was a physical, tangible thing both technically

1. *American Machinist*, 28 Jan. 1957.

and economically. It was not like a tribal fear of being bewitched—a type of mass psychology that does not radically change the technology of a culture. In order to develop a theory of a psychologically-propelled second industrial revolution it would be necessary to show that there is—to use the language of automation itself—some 'feed-back' from the hopes and fears created by automation to the process of automation itself. A case in point would be the psychological effect of automation as an encouragement to workers to push for higher wages, shorter hours and other advantages that tend to raise costs for management. In practice, Mr. Staehle suggested, these benefits and the consequent rising costs would apply to workers on both automated and non-automated projects. Then rising costs would lead management to adopt more automation to which workers would react again. Here we have the picture of a cumulative process that might become important—even perhaps to the point of being considered a revolution—although no single step in the process could be considered of decisive importance outside this total context of action and interaction. Not all such cumulative processes are revolutionary; some peter out very quickly. But it is by thinking along these lines that one may be better able to appraise the impact of automation.

UNEMPLOYMENT

As was suggested above, the Study Group was particularly concerned with the fears and anxieties arising from automation. These were considered to be important not only in themselves but also in relation to their possible reciprocal effects on automation itself. One of the most important of these fears is that of unemployment. Unemployment resulting from automation may have much more severe psychological effects than other types of unemployment because the worker may forfeit his skill as well as his job. As Mr. de Bivort expressed this point : 'The man who traditionally lost his job or who loses his job now in most industrialized countries can expect a reasonable degree of protection for a short period through unemployment compensation. But the man who loses his job because of automation is perhaps also losing the advantage of his skill because the new types of production no longer require it. This situation poses a different type of problem. Under these conditions the worker is not only an unemployed man because his particular job in the old plant has vanished. He has lost his place in society unless society represented both by industry and by government, recognizes its responsibility to help that man through a very complicated process of re-adaptation to a new job.'

Mr. de Bivort doubted however if the direct impact of automation on employment would be really serious: 'Reasoning from the consequences of what automation has already done in certain extremely limited sectors of the automobile industry in the U.S.A., Walter Reuther has argued that, if the entire industry were automated, the million workers now employed by that industry could be replaced—assuming the same volume of production—by 200,000 workers. A displacement of 800,000 workers, even if it were spread over a reasonably long period of years, does of course constitute a social problem of very considerable dimensions. By way of contrast, we might consider another example also provided by the automobile industry. The Ford Motor Company employs some 140,000 workers in its U.S. plants—a recent news release by the Ford Motor Company indicated that, of this total of 140,000

workers, approximately 2,000 were actually on automated jobs. This is a fair indication of present limits to the full use of automation, even in industries which have obviously taken to it very actively.'

There may, however, be indirect, less evident, effects of automation on employment. As Joe Hoffer of the International Conference on Social Work suggested—and this point has since been confirmed in the most recent annual report of Walter Reuther of the United Automobile Workers—not all of the fear of automation is derived from the threat of over-all reductions in employment in a plant. The fear is rather that, partly as a result of the possibilities which automation offers for the decentralization of industry, because of improved feed-back control and computer technologies, plants would be moved and workers might either be dismissed or not given the necessary assistance to move with the plant. Such an eventuality would have indirect effects not only on the workers themselves by saddling them with the costs and inconveniences of moving or even of losing their homes, but also on incomes and on employment in small businesses which might be deprived of some of their best customers.

There are other types of unemployment which could result indirectly from automation. The firm which adopts automation might be able to expand its markets and perhaps even to increase employment. But its perhaps smaller competitors might be squeezed out of the market, and in these firms unemployment might be severe.

There is the possibility that should automation reduce employment there may be a large enough number of workers retiring, quitting jobs to get married or otherwise withdrawing from the labour force to prevent unemployment in the sense that workers would be forced out of their jobs. But that is only one aspect of the question. With a lower level of employment there may also be a reduced number of new job opportunities and unemployment may appear predominantly in the form of a shortage of openings for young people looking for their first job.

These varying indirect effects of automation in a particular plant on employment in general show that great care must be exercised in adopting procedures for measuring the effects of automation on unemployment. It might, for example, give inaccurate results to ask only the firms that have adopted automation whether or not they had laid off any workers and if they had not, to conclude that automation, at least in the short run, had not caused unemployment.

Dr. Charles R. Walker of the Institute of Human Relations at Yale University suggested that workers might also fear, sometimes with good reason, that automation would result in more unemployment in the 'next depression'. When automation is adopted, markets may be expanding and workers who are not really needed may be retained on the pay-roll of a plant in the hope that they will be needed later as markets are expanded further. If there were a reversal in business conditions, however, production might cease to expand or might even contract, and workers already made redundant by automation would then be actually laid off.

The problems considered above relate to the ways in which automation in a particular plant may affect employment in the whole economy. The Study Group also attempted to throw some light on the problem of how the over-all level of automation would affect over-all employment. There are three aspects to this problem: (a) the extent to which automation may cause frictional unemployment, that is unemployment that can be remedied—at least in

principle—by the worker changing jobs; (b) the extent to which automation may result in unemployment from lack of sufficient demand; and (c) the extent to which automation may cause unemployment by making the impact of business fluctuations on employment more severe.

On the first of these points there is an economic theory which explains the conditions under which an improvement from automation or from some other technological advance will result in frictional unemployment. A technological advance will on the one hand have a displacement effect in that a relatively smaller number of workers will be required to produce a given volume of output. There will be, on the other hand, a demand effect. If prices are lowered because of the lower costs resulting from a technological improvement, and if consumers increase their purchases as prices fall, there may be a demand effect sufficient to overcome the displacement effect of automation.[1]

Mr. Levinson argued, however, that there is not likely to be much reduction in prices on the part of most manufacturing firms even if costs of production are reduced. Furthermore, at least in poorer countries, there may not be much of an increase in sales to consumers even if prices are reduced. With regard to the first of these points, it was suggested by other members of the group that the equivalent of price reductions might, however, occur in the form of quality improvements without a corresponding rise in prices, or that there might be a general rise in price levels but that the price of products affected by automation might not go up so much. Then if the relative rather than the absolute price declined, there might be an increase in demand for a product affected by automation.

Finally, in principle, unemployment resulting from automation can be overcome if (a) workers can change jobs easily, and (b) if the total level of demand is or can be kept high. The first of these points will be discussed in detail below. The second point involves the total level of demand. In principle, if automation lowers costs without lowering prices, there will be a rise in profits and if the profits are spent more jobs will be created in other industries. If prices of automated products are lowered and consumers spend elsewhere the money which they might save as a result of the lower prices of automated products, then there should be increased production and employment in non-automated industries. These two types of increased demand by producers making higher profits and by consumers with more money to spend on non-automated products, should be sufficient (always with the proviso that workers can move between jobs) to overcome any temporary frictional unemployment between jobs. It may be feared, especially in the United States, that these savings resulting from automation will not actually be spent to make more employment. This fear applies especially to profits resulting from automation. Then there would be an over-all lack of demand and unemployment of the depression type might result. Mr. Levinson put this argument as follows: 'For example, in the United States, automation has developed today to the point where it is certainly a national problem. It is creating some problems, from the point of view of the trade unions and collective bargaining, of real

1. It might be argued that the demand effect side of this kind of analysis would not apply to office work, a field not considered in detail by the Study Group, but one in which automation is certainly important. The demand for records and computations in offices may not, however, be fixed in quantity. Computers may make information available to management at a lower cost and more rapidly. Under these conditions management may increase its demand for office services and thereby to some extent offset any displacement effects of automation on employment in offices. This point is stressed in the May 1957 issue of the National Industrial Conference Board's *Business Record* (New York).

concern about equilibrating demand and production. Annual productivity—which is now increasing at the rate of something like 4 per cent in place of only 2½ per cent a few short years ago—means that our concern with making certain that the consumer demand is at a level to buy this production is a problem to which every unionist is going to have to address himself, because it is almost impossible to determine consumption patterns on the basis of a salary policy in one given industry. For example, take the automotive industry. It is unrealistic to assume that the salary policy developed by the United Automobile Workers, even if successfully applied, could create new conditions so that the effect of consumer demand for automobiles, upon which the employment of automobile workers depends, could be safeguarded. This means that the increased productivity in the automotive industry requires the union to pay more attention to national policies on the part of the government to sustain a national level of demand, because it is obviously not only the automobile workers who are going to buy those cars.'

Mr. Kaser believed, however, that employment would be maintained at least for a considerable time in the future, as a result of an increased demand for machinery and equipment: 'Now, in so far as highly developed economies are concerned, one can see very little fear from automation. There is a very strong effect on employment in the manufacture of the automatic machine. It is not simply that the new automated machines themselves occupy so many more man-hours per unit to build than the machines they are in effect putting out of use; what is important here is that the machines now being replaced, would, under normal conditions, have fallen out of action at some future date. The employment requirements of stepped-up replacement of machines will, in fact, very considerably offset the withdrawals of labour in the industries in which those machines are installed.'

Mr. Kaser's view is perhaps supported by the tendency of the machinery industry—perhaps in part due to the new outlook implied by automation—to be characterized by much stronger salesmanship during recent years. Referring to this line of argument Mr. Levinson commented: 'Now the machine-tool industry, or the industry which is producing automatic equipment, is in itself introducing a change which we think will be very significant. First you have industries which are devoted to thinking up automatic processes for another industry. For example, a firm concerned with the manufacture of, let us say, baking equipment for the industry will now concentrate on thinking up automatic equipment and machinery. It will go to the baking industry and make a proposal for its introduction. And more and more this specialization is coming into being, where the production of automatic equipment is introducing a new feature into industry. This is quite different from the situation that obtained in the past. You will remember for example that, when the famous Ford Cleveland plant was set up, it was essentially the Ford engineers who thought up their own solutions to their own production problems. In Europe, Fiat or Renault have *their* engineers and *their* machine-tool departments think up the automatic equipment that they need for their production. But now there is a growing machine-tool industry devoted to the production of automatic equipment and sending out engineers and specialists to propose the automation of production. So you will have a new feature added to the whole situation and it will no longer be a question of the industry itself thinking up its own processes. You will have specialists and engineers and technical people who now are doing nothing except thinking up new

automatic processes and selling them like you sell any other product.'

In recent years machinery manufacturers have developed much more precise methods of evaluation and forecasting, and they are thus able to show that the new machines will pay for themselves in a relatively short time. Machinery sales have also been encouraged by changes in tax laws regarding depreciation allowances. There are now also more special arrangements for renting machines or selling them on credit.

In considering the effects of automation on employment, Mr. Levinson raised a third point, to the effect that automation might make employment more vulnerable than ever to even minor business fluctuations. He argued that, under mechanization, because of the time required to complete processing of only partly finished units of output, production and employment could only be contracted gradually in response to a business reversal. The speed and organization of automated processes made it possible, however, to close down a whole section of a factory if there was a decline of sales of the product:

'You now have machines, for example, where one man produced, let's say five years ago, ten years ago, X units of output. Then there was a cut-back when they produced too much. For a cut-back, let us say of 20 per cent of their production, they might have had to lay off say 10 per cent of their personnel. Today, that one man produces X plus 20 units and if they get a cut-back in demand, and they want to pull back say 20-25 per cent of their production, they're going to lay off a proportionally much greater number of people for the very reason that you have got a dilution of the number of people in the production lines, and if you stop a sector, you stop a whole factory, since you have a smaller number of people to begin with who are producing the cars in this given factory.

'This experience was borne out in 1956 when there was a down-turn in the automotive industry. At the top of the slump in June, there was a 28 per cent production cut-back. The number of cars produced at that period, as compared with 1955, was 28 per cent less, and they laid off something like 25 per cent of their work force. In 1954, when there was a small recession, they had a cut-back of something like 10 per cent, and they only laid off about 2 per cent of their work force, because, to maintain that smaller percentage, the workers were still necessary on the lines. But today, when you cut back, you can cut back a whole department. If you have three assembly lines, you shut down a whole line and two lines will work. Everybody on that line will come out. In the past, that was not the case. They would slow down, for example, but they would not shut down. What has resulted from a higher productivity is the better rationalization of production facilities, and this feature is now, I think, built into the problems of automation.'

PROBLEMS OF CHANGING JOBS

As was suggested above, many cases in which automation displaces workers from their jobs can be overcome by changing the worker's job either within the plant or to some other plant. Under these conditions no unemployment is caused by automation, but the new job may involve the worker's learning a new skill. Physical and psychological adjustments to a new skill may be difficult in themselves and, perhaps more important, may cause fears and anxieties.

Several members of the group, especially Mr. de Bivort and Mr. Ewing, called attention to the new skill requirements of automation. Mr. Ewing made particular reference to the need, under automation, for engineers and highly trained technicians: 'The main trend since the industrial revolution, in the highly mechanized industries, has been to reduce the demand for skill and to create more and more openings for semi-skilled or unskilled, workers, each person normally carrying out endlessly one operation as the conveyor belt moves past him. In the long run automation is bound to save labour, and particularly semi-skilled and unskilled labour, but it will increase the demand for skilled labour. In particular, engineers and technicians with a specialized knowledge of automation techniques will be required in increasing numbers, and, in addition, management with new skills will be needed. It seems that the engineers should, ideally, have a wide background in both mechanical and electrical engineering and in addition a knowledge of modern statistical techniques. Management seems likely to become a much more complex business in that it will be less purely the management of people and more the management of extremely complex and expensive machines.'

Mr. de Bivort stressed the way in which automation would change skill requirements for workers and for management:

'The two occupational groups we are discussing here might well be defined in terms of the semi-skilled worker who is responsible for operating ordinary semi-automatic and automatic machines. His function to a great extent consists in watching the machine, seeing that it runs correctly, calling for help if anything goes wrong, and feeding it, that is actually placing the parts into the machine for the operation that has to be performed. This types of worker is likely to be replaced, largely, by automatic devices. He has been replaced by another type of individual, whose skills may not be very extensive but whose understanding may have to be somewhat broader than that of the traditional machine operator. Let us take an example, one of the job-types about which there were actual negotiations for a collective agreement between the United Automobile Workers of America and one of the automobile companies. Grinding operations, each of which was performed by a grinder operator, were replaced by an integrated line of grinding machines fully automated and requiring only a form of supervision. The grinder was then no longer in direct contact with the parts being worked by the machine but needed only to go back and forth, watching a series of automatic units at work and making sure that this complex was operating properly. This type of man needs a certain alertness and an ability to see much more than the traditional semi-skilled worker.

'Here we enter again into the area where we are not quite sure. In some cases at the time when new machinery was put in, it was planned to have a number of technicians in addition to maintenance workers to keep the machinery going. Experience showed after a time that a normally competent skilled maintenance mechanic with the necessary training in very elementary electronics was perfectly competent to take care of the maintenance and repair requirements of these machines.

'Another area where important changes are in the making is in management. The running of an automatic plant implies definitely greater management skill—much more than simply watching to be sure that the employees are working hard. In the first place, this situation is like replacing a reasonably slow-moving machine by one of high speed, let's say a traditional type of

transport plane by a jet plane. Things happen faster and their consequences when they go wrong can be much more severe. Therefore, management must be much more competent and able to use finer tools than the traditional type of supervisor was required to be able to handle. Among the many problems that will arise for top management is that of gaining much better understanding of the people it has to work with. Mr. Ewing made the point that management would be faced with the problem of managing machines of a high complexity. But that is not all—it would be managing those machines by means of people who would also require more skilled leadership on the part of the top management. It is also obvious that the management of an automated plant can afford far less than formerly to face either intense discontent on the part of its workers or, what is even worse, the threat of a strike or an actual strike. This means that management is going to have to move much further ahead in its understanding of how to manage people, even though its main fixed resource may consist in valuable machinery.

'With respect to middle management, leadership skills will also need to be considerably improved. Working in an automated plant often means, for a foreman or for a supervisor, that he is working with a small team of skilled people, each with a very definite responsibility and each requiring more skilled leadership.'

PSYCHOLOGICAL PROBLEMS OF NEW SKILLS IN AUTOMATION

When a worker is obliged to change his skill, the problems which arise are of two separate kinds. First there is the problem of learning a new skill. As Mr. Levinson suggested, this problem may be insurmountable especially for older workers. Perhaps more important than learning a new skill or responsibility is, however, the psychological adjustment involved in overcoming fears and anxieties associated with new skills or responsibilities. Such a psychological adjustment may be difficult even though in a formal sense the worker had already learned the new skill.

A considerable number of psychological problems that might arise in adjusting skills and responsibilities under automation was brought to the attention of the Study Group by Dr. Walker, Dr. Krapf and Mr. de Bivort. It may be interesting to compare, as Dr. Walker did, some of these difficulties with those which arise under mechanization. One of the greatest psychological difficulties of mechanization was that it forced the worker to adopt the same pace of work as the machine. As Dr. Walker suggested, workers forced into the fixed pace of an assembly line tend to transfer to management their dislike of the control imposed by the machine: 'Anyone who makes a machine that does that to us, must be like the machine.' Dr. Walker noted, however, that when the number of elements in a job increased—as might be true under automation—the dislike of management tended to decrease. This result had followed when the number of elements in a job had increased from 3 to 10 for instance. On the other hand, automation may increase the worker's fears and anxieties about being 'pushed around', because not only muscle but also brains are being replaced by the machine. Dr. Krapf expressed this idea in the following words: 'For the first time, we have to do with a machine which not only replaces human muscle, but which actually replaces the human brain and which, therefore, has a considerably deeper impact on

human pride, on human ability of identification, on the whole situation of man in his cosmos, so to say. In other words, there is something far more uncanny about automation than there has been about the ordinary type of industrialization.'

In this connexion, it might be suggested that some incomplete types of automation, in which the human brain may still have a part in the feedback process, may be more psychologically damaging than a fully automated process, because the pace of work of a man's brain as well as that of his muscles may then be set by a machine.

Under mechanization, one cause of psychological difficulties was that the job often represented such a small part of the final product—in an assembly line for example—that it had no meaning for the worker. The job was too small, it had too little content, to be appreciated. Under automation, on the other hand, most jobs are likely to produce bigger results than a very small part of an assembled product. But jobs may be too big, they may have too much content, and, especially in electronics, they may be too abstract to be easily understood. Thus the meaningless work portrayed by Charlie Chaplin in 'Modern Times' may be replaced by the meaningless work of a control operator who, although his work affects the whole product, may be actually the victim of a set of directions which tell him, for example, to pull a certain control when he receives a certain signal. He may be able to obey such rules without knowing how such controls affect the operation of the plant.

Several members of the Study Group stressed the changed nature of fatigue that is likely to result from work on automated systems. The worker who moves to automation from a place on an assembly line faces basic physical and psychological adjustments. On the physical level, he gets very little exercise and this exercise, if any, is necessary only when he must make an adjustment in the production process. Such physical effort lacks the rhythm of the muscular effort of work on an assembly line. The change from work on an assembly line to work on an automated process creates a great psychological difficulty in that while the worker must be 'at attention' without doing anything, he must be ready to act quickly if there is a breakdown in the production process. This constant demand for alertness is, of course, incompatible with the day-dreaming that was often fully compatible with good work on the assembly line. Dr. Krapf described this point thus: 'So far, one has always been expected to pay attention to something if, at the same time, one was expected to act. Now, for the first time, it would seem that people are being forced to pay attention to something which forces them to remain passive. In other words, you have active attention, and passive motivities. This is a new experience for which mankind is so far not prepared, but which mankind is able to learn, because mankind can learn anything. Nevertheless, it is again an anxiety-producing factor, and, it would appear that, certain qualifications being necessary for this type of work, only a certain type of person will be able to perform it satisfactorily.'

This kind of requirement 'to stand at attention' waiting for something to go wrong—the change-over from a production job to a watchman's job—can result in a special type of non-muscular fatigue known as perceptual fatigue. And this type of fatigue may be even greater if the worker tends to have an over strong sense of responsibility, if he is preoccupied by the thought that a mistake means the loss not of a particular part in a process, as it would under

mechanization, but of a whole batch of the product, or that it will mean severe damage to a very expensive machine.

Professor Walker noted, however, that much of the evidence is unclear on the question of perceptual fatigue.

'What is usually discussed as perceptual fatigue or nervous tension', he said, 'poses a problem of real importance under certain conditions. But our case-material is inadequate and contradictory. Many of the workers whom I interviewed in my study of the automatic steel mill were under grave strain on certain jobs, and some of them were sufficiently unhappy to quit. They complained of the fatigue of doing nothing, of standing at attention, so to speak, all day at controls, ready to intervene if something went wrong. Such a job is much more tiring, they insisted, than jobs in which they could use their muscles. These workers, however, did get some relief when what is known as change-overs were introduced, that is when the mill was re-set for a new order or product. Also, although they were production workers, they were taught a good deal about the automatic machinery which they operated, and they were capable of making minor repairs on it. The job of the platform operator, as he is called, who never leaves his control board of buttons, levers and lights, and who really governs the operations of an entire automatic factory, as in oil refineries, for example, translating mathematical calculations into remote physical effects through his control board, is obviously of a higher and different order than the job of the man I have been talking about. Here, not only alertness is required, but experience and judgement and abstract thinking.

'Testimony from the material gathered for the recent automation conference, in Paris, on the subject of perceptual fatigue, is suggestive but contradictory. A German commentator remarks: "The automatic machine calls for constant alertness and not all the workers are capable of this sort of concentration for long periods." The writer of the case study of the Renault autoworks says that automation increases the responsibility of the workers, the need for a higher degree of concentration and a better understanding of the function of the machine. The Renault study concludes: "This, undoubtedly, gives rise to a new form of fatigue, but it is accompanied by the satisfaction of doing more interesting work and by higher wages." To sum up, the whole question of perceptual fatigue and nervous tension needs a great deal more research.'

The problem of perceptual fatigue involves a worker's relationship to the machine. What is perhaps even more important, from a psychological point of view, is the extent to which automation changes the worker's relationship to other workers. Dr. Walker summed up this point: 'Now, if automation has revolutionized the substance of man's work, and the skills which he must acquire to perform it, it is having an equal, if not greater effect, on his social relations in the factory, and outside it. A series of studies undertaken in all countries, and extending over many years, ever since, I would say, Elton Mayo's famous Western Electric Research, have demonstrated the importance of socialization for every man in industry—the importance of the primary work group, and of the larger work communities as well, to a man's mental health and to his satisfaction and happiness at work. Man is certainly gregarious at work and at play. There are few natural isolates, at least in the industrial world. So, what will automation do to the instinct and practice of socialization in the modern factory? Could it destroy it? The ILO reports that many workers

in automatic plants tend to be entirely alone through the whole of their work period. At the Renault auto-plant, in Paris, for example, the only human contacts for certain workers during the workday are provided by the visits of the technical machine-setter. On the other hand, a study of a large automatic power plant in Michigan, which replaces a non-automatic one, shows the workers in closer functional personal relations than on their former jobs. In my own research, I have found certain automatic technologies which encourage team-work.'

On the question of loneliness in so far as it does arise from automation, some members of the group noted that some other occupations, by no means automated, as for example agricultural work, might also be lonely. The psychological problem in changing over from mechanization to automation was, however, one of a change from relatively gregarious jobs to lonely jobs.

Apart from pure loneliness, automation may create situations in which workers may be in proximity to each other but in which, during the course of work, fewer personal contacts are required or possible. Then the mixture of work and social contacts, often found under mechanization, is lost. The substitution of a person-to-machine relationship for a person-to-person relationship may create psychological problems. Dr. Krapf noted case studies showing that neurosis was more frequent among workers who fed supplies to machines than among workers who fed supplies to other workers. It may turn out, in some cases of automation, however, that while personal contacts may be fewer in number and restricted to smaller groups, the automation groups may be more cohesive and better oriented psychologically than the larger groups found under mechanization. Professor Walker called attention to a plant in which automation reduced the work group from 30 to 9. The members of the nine-man group were more united even though they were scattered over a wide area in the plant.

AUTOMATION AND THE COMMUNITY

Up to this point the Report of the Study Group had been concerned mainly with the economic and psychological effects of automation on the individual worker or work group. Several members of the Study Group, however, were also concerned about the possible effects of automation on the morale and stability of whole communities .They felt that two developments of importance to communities were associated with automation; these were (a) the greater importance of shift work and (b) increased leisure time for workers.

Some members of the group were of the opinion that shift work and increased leisure time, while subjects of great interest, were dependent on a great many factors in society other than automation. This being so, the analysis of automation might not contribute to an understanding of these problems. The very nature of some problems of unemployment, training or psychology depended on whether or not they were caused by automation. Shift work or increased leisure, however, might not give rise to significantly different problems simply because they were due to automation. A worker might be on shift work because a firm without a significant degree of automation had heavy capital investments, or had more orders than could be filled by working one shift every 24 hours, or—as is the case in even old-fashioned blast furnaces — had a technological process that it was uneconomical to stop at the end of a

single shift. Shift work arising from any of these causes would appear to create much the same social problems as those arising from automation. Shorter hours of work and more leisure might likewise arise from technological improvements not usually associated with automation. Increased leisure time would thus seem to raise the same social problems regardless of whether it developed from automation or not.

The Study Group thus did not appear to have demonstrated any special way in which a knowledge of automation would contribute to an understanding of the problems of shift work and increased leisure. The group did, however, produce a number of interesting observations on these problems. With respect to shift work, Professor Walker noted: 'There is no doubt that automation is already upsetting the existing balance—the existing continuum— between a man's life at work and his life outside. The capital structure of the average automatic or semi-automatic factory is obviously the controlling factor. Investment in automatic machinery in any plant must be large; that machinery must be kept operating continuously round the clock in order to be profitable. So, it is not hard to visualize the impact on a community accustomed to one day-shift operation, and abruptly reorganized on a three-shift basis. Let me give you a simple example taken from the recent experience of an English mill where automatic equipment has imposed the three-shift system on a few hundred people. When asked in what way they had been affected by the change —the introduction of automation—51 people mentioned the loss of weekends and the consequences to social and family life; 45 of those questioned, according to the report, were not indifferent to the subject. Particularly the loss of Saturdays and of sports events touched them, both as players and spectators. One mentioned having to give up Sunday school, another having to take a less active part in political life. Again, 38 of the men and 17 of the wives interviewed complained that continuous work had forced them to give up regular participation in sports clubs, social, religious or political organizations. But the most important part of this study is concerned with the dissatisfaction of the wives in general. If this experiment, which affected perhaps only 200 or 300 people, be multiplied by the number of plants likely to introduce three-shift operations into one-shift communities, then something of the scope and extent of probable community disturbance can be estimated. Dr. Krapf suggested one or two other broader repercussions of automation, both in the family and community, and beyond. He noted that studies had shown that the rate of juvenile deliquency, I believe I am right, was higher among children whose fathers or mothers worked at night. But he also pointed to the more general possibilities of social cleavages, with accompanying resentment and frustration, between that portion of the population in which work or leisure was governed by the automatic factory and that part of it not so governed. These are certainly possible trends which should be watched by researchers and practitioners in mental health.'

Mr. Kaser, on the other hand, did not envisage such a disruption in human relations even if 24-hour shift work were adopted. He suggested the possibility of a 30-hour week, for example, on a five-day basis, which would mean four shifts a day of six hours each. A worker could conveniently fit this into a 'normal' life. Friends would be made in the same shift, leisure-time services would adapt to serve the new shifts and developments such as morning baseball teams would follow.

Mr. de Bivort called attention to some of the social problems that might

arise from shorter hours of work: 'There is another very wide area that I merely want to mention, which concerns the consequences of a reduction in hours of work. I think that we should be well advised—this is my personal opinion and I put it forward for what it is worth—to envisage this generalized reduction in hours of work as still being a long way off. But it is something that merits careful thought right now, because, when it comes, it will mean vastly increased leisure for a great number of people. Reduction in hours of work is not going to happen in all likelihood within one sector of industry. And with those wider opportunities for leisure-time activities, the kind of activities available to people and the location of the grounds or premises provided for this purpose will be of tremendously increased importance. The vicious aspect of the present industrial residential community in the suburbs of large cities will become even more obviously a threat to social stability, and its damaging effect on the people who live there will become even more obvious. Along with leisure, there is no question but that the problem of education—education tied in with the development of people through formal training and accompanied by widened opportunities for them to understand and enjoy the life that goes on around them—will also need to be taken into account.'

Mr. Joe Hoffer also noted the difficulty arising from the fact that, if hours of work were shortened to provide for a four-day week, the school programme of children would not correspond to the work schedule of their parents. Children in school had summer vacations mainly because, historically, they were needed for farm work during the summer months. The five-day school week combined with a summer vacation would not, however, correspond with the four-day work week. It would interfere with parents getting the most benefit from a three-day week-end.

AUTOMATION AND CONFLICT

As was suggested above, on an individual, group and community level automation may create a considerable number of problems of psychological adjustment. If these adjustments to automation cannot be made smoothly, the resulting frustrations and neuroses are almost certain to produce aggressive patterns of behaviour.

Aggressiveness provoked by imaginary conflicts can easily follow frustration. In the case of automation, however, there are conflicts that are, at least potentially, very real. To a great extent the conflict situations arising from automation tend to run parallel to those effects of automation that tend to create fear and insecurity. As was noted above, perhaps the most important of these is the fear of unemployment. Fear of unemployment has not, as it sometimes did in the first industrial revolution, created an opposition to machines *per se*. It has, however, been accompanied by strong doubts on the part of workers as to the willingness of management to make reasonable efforts to minimize unnecessary hardships and unemployment that might result from automation. Management, on the other hand, may argue that the employment effects of automation are grossly exaggerated by trade unions, partly in order to give force to their arguments for shorter hours of work. Mr. Levinson expressed the trade union point of view in the following words: 'Our experience to date suggests that we are already in a conflict area on automation—that's the first point that I would like to make. But quite apart

from the problems peculiar to a given plant in a given area, there are already differences of opinion and unwillingness actually to come together to discuss the problem *per se*. Management seems to want to hide as much information as it possibly can. It is not easy to elicit the information and to carry out the type of case study needed to make our general view of the situation really meaningful. Thus we are forced to assume a lot of initiative and, in fact, to wage offensives before the battles even appear in order to provoke this particular type of interest on the part of governments and on the part of other organizations, so that we do get to the discussion of the information before we are actually confronted with specific problems in a negative sense.'

Mr. de Bivort, however, stressed the fact that the fear of unemployment, and in fact most other potential conflict situations arising from automation, would be easier to solve if more properly timed information were available and acted upon in a spirit of union-management co-operation. 'Walter Reuther has said quite frankly, "We welcome automation". It holds the promise of a better world for everyone on certain conditions—and the conditions are everything—on condition, for example, that this new world is not brought into being without taking account of the workers, that this new world is not brought into being solely for the profits of management, that this new world, when it comes will bring with in benefits to all sectors of the community, benefits in the form of higher standards of living, of new goods and services, of higher income for the workers and of more leisure. Problems raised by automation will have to be solved through more satisfactory labour-management co-operation, first of all within the plant concerned, and then at the industry and at the national level when the problem gets beyond the limits of an individual plant. Within the plant the easiest way to envisage these problems is probably to pick up some of the points which I have already mentioned and to recall the fact that from the point of view of management, from the point of view of getting maximum smoothness in operation, it is going to be essential to forestall the worker's legitimate fears. Now that can be done, of course, by sending out notices and advising everybody in perfect good faith ahead of time of what changes you propose. This device works to a certain extent. It does get rid of rumours; it does remove some of the workers' legitimate fears, but experience has shown that where changes are taking place rapidly, in an industry or in a particular plant, much more is needed. There is also need for frank consultation and for a willingness, not merely to inform the workers, but to give them a basis for discussion. The workers should at least have a chance to say, either through information pools and public opinion inquiries or through consultation with their representatives, just what they think of the changes which are being made. Their suggestions, intended to meet some of the difficulties they are faced with, should be considered by management. Sometimes such suggestions may prove to be excellent—to be genuine improvements on the solutions worked out by management. Sometimes it will be of advantage to management to accept those solutions as alternatives to the scheme they have worked out themselves, whether it is a question of reorganizing a production process, whether it is a question of a new lay-out for a department, and even more important of course, when it is a question of '... your group, 10 or 20 per cent of whom cannot remain. Now we have certain alternatives to offer you. We can retrain you and place you in another job in the company or we can help you, if you choose to leave the company. Then you will receive dismissal compensations and assistance in finding new employ-

ment'. Obviously if these questions can be put to the workers in an orderly way, in advance of the time when they will have to take decisions, and in such a way that they themselves can bring back their own reactions and put them before management and get a fair exchange of views, the chances of their being able to make the passage to a new form of organization are much more hopeful. The chances of relatively easy adjustment, if negotiations are carried out that way, are much better than if things are done in the manner so very unfortunately adopted at a large motor works in England recently. That, in some ways, was a perfect example of what should not be done. A most enlightening comment was overheard by one of my colleagues in a pub in Coventry. One of the workers, talking over what had happened, objected to the 'impolite' way in which they had been put off. This was not an expression of resentment because of unfair treatment, or because of the genuine difficulties a lot of workers had been faced with, it was an expression of indignation at the abrupt inconsiderate way in which the workers were suddenly notified of their dismissal. It was all very well to say that there was full employment in England and that they could get new jobs; many of them did, but at lower wages, and people in England, like people everywhere else, are now committed to hire-purchase arrangements and are faced with definite time limits within which they have to pay certain definite amounts. If their wages are suddenly cut, and cut seriously, they can't very well readapt. These difficulties are even greater if they have to change their location, and move their families. The reaction of this worker was, therefore, a very interesting one. It showed that the man felt that he had been ill-used as a human being by another human being and that proper consideration for him had not been shown. It is at least a warning of some of the problems that management is most certainly going to have to face and of a new type of attitude that they will encounter more and more from their workers.'

Mr. de Bivort suggested that much the same procedures as those mentioned earlier should apply to most of the other problems raised by automation within the plant itself. In the Study Group there were, however, different interpretations of how increased productivity from automation would affect wages and hours of work. On the one hand, Dr. Krapf believed that shorter hours for workers in automation might create tensions between such workers and members of the community remaining on longer hours. 'The automated factory will create what you might call dissociation of the working rhythms. What I mean by this is the following: In an automated factory you will have one type of work rhythm, say, the six-hour day, but there are quite a number of professions where the introduction of the six-hour day is absolutely impossible. I am referring to the more personal professions such as nursing, teaching, and other occupations in which people are unable to use machines as a substitute for human contacts, and in which a shift of six hours is a practical impossibility. There will probably develop a split in the population between the "automated" and favoured persons working the six-hour day and the "non-automated" and disfavoured persons who would have to work longer.'

Other members of the Study Group, however, took the view that there would be a marked tendency for strong trade unions and other pressure groups to urge that the same gains be granted to workers not on automation. Exaggerated hopes raised by automation might tend to push up wages and other incomes faster than productivity. Mr. Staehle suggested that the high wages obtained by workers on automated projects might lead to similar

demands from workers on non-automated projects. Then there might be a problem of wages outrunning productivity and causing inflation to the detriment of the interests of the whole community. There was the danger of 'encapsuling' the demand for shorter hours of work to include workers in both automated and non-automated plants.

In addition to conflicts on over-all wage levels and hours of work, tensions and aggressiveness may arise from the impact of automation on job classifications, incentive systems and methods of job evaluation.

Mr. Levinson stressed the fact that automation drastically alters wage structures; for example, incentive wage schemes are thus rendered out of date. He continued: 'In general, in an establishment, the pay scheme is arranged to consider the smallest group as a unit in order to harness incentive. Under automation, on the contrary, production is a continuous flow. Therefore, it would be wrong to apply present salary scales directly to an automated system. Management operates at present on such a pay scheme, but it must take into consideration the shape of things to come, as in the automotive industry in the United States where the whole wage-incentive scheme is eliminated.

'So we have the factor of skill greatly diluted in the new set-up, and the question of job evaluation presents itself. Management must reorganize its thinking on this subject. In the trade union movement, we have adopted the following position for long-term consideration: we are making an effort to downgrade the importance of skill on the part of the worker, and to upgrade the importance of the effect of the fatigue and monotony factors. During the intervening period of transition, the trade unions are opposing job evaluation and wage-incentive schemes.

'Scientific management techniques, which are simply a disguise for methods of forcing increased productivity, are being more and more strongly opposed by workers. Since automatic equipment reduces the human element, the principle of increased production is based on the elimination of this factor. Thus the question of efficiency in the human element is removed. We must take care that in the resulting shuffle, since this most important contribution which emanates from workers is done away with, proper consideration of the workers involved is not forgotten also.'

Mr. de Bivort also considered it of the utmost importance that these adjustments should be made if conflicts were to be avoided: 'There will also be a need for re-examination of a great many elements in industrial practice and of these I simply name a few as examples: Salary structure will need complete revision in terms of the new types of job, along with new job classifications. There will probably be an almost complete elimination of the current types of individual incentive to be replaced by newly found types of incentive, for example, incentive wages connected perhaps with the ability of the worker to keep the machines going with a minimum of down-time. Since the worker no longer controls the rate at which the machine operates or at which his output is turned out, the classical incentive wage that depended on the number of units produced, has obviously no more meaning.'

While most of the discussion in the Study Group was concerned with personal and social difficulties and with conflicts that might arise from automation, it was by no means a discussion with a bias against automation. Perhaps in part as a result of Mr. Choisy's and Mr. Ewing's exposés of the advantages of automation, the long run potentialities of this new development in terms of increased output and greater welfare were accepted by all members of the group. These points were too obvious to examine further and most of the discussion centred on how to deal with problems arising from automation.

There was some feeling in the Study Group that through the process of overcoming problems raised by automation, society might also be able to cope with many typical pre-automation personal and group problems and conflicts. As has already been pointed out, automation, at least on a technical level, tends to demand a rethinking of production processes; the same may apply to some dynamic social processes. Professor Walker remarked in this connexion: 'Whatever automation is doing to the character of human work, there is no question but that it has thrown the spotlight of popular interest on the subject. In fact, there is a danger that the research and action groups in all nations may devote themselves, wholly perhaps, to the automatic sectors of the world's economy, to the neglect of the less spotlighted but still important segments of old-fashioned industry. Personally, however, I have good hopes in this matter. It is now a commonplace thing among employers, as well as among automation experts, to say that the most valuable result of installing high-speed automatic computors is the compulsion to rethink, company and plant organization, imaginatively and intelligently. So, I am hopeful that one of the most valuable results of the whole automation episode in human history will not so much be an increase in economic wealth—although that is important—but a rethinking along more rational, far sighted and imaginative lines of the whole of work and of the human relationships connected with it in the modern world.'

Stressing the positive advantages of automation, Mr. Ewing was especially concerned not so much about the transitional disadvantages, which are bound to accompany it, but rather about the possibility of immediate obstacles to its development becoming even more formidable. The obstacle of the shortage of skilled manpower has already been referred to. Among other obstacles to the application of automation technique, he mentioned the heavy demands it would make on electric power supplies which are likely to remain limited for some time yet, at least until atomic energy can be developed. There are likewise limitations to supplies of raw materials and to the capacity of industry to produce equipment for automation. With regard to the shortage of means of producing complex machine tools, Mr. de Bivort noted that, in private correspondence, Carroll W. Boyce, the editor of *Factory Management*, estimated that it would take roughly 15 to 20 years for the machine-tool industry in the United States, with its present capacity, to supply equipment for automation to 16 per cent[1] of the U.S. metal working industry.

Another possible obstacle to automation, especially in Europe, might be encountered in the inadequacy of capital resources to finance investment in automation. Mr. Ewing noted that: 'On the availability of investment capital it is impossible at the moment to do more than generalize, in the virtual absence

1. This is, according to one estimate, the percentage of the U.S. metal working industry that can be automated.

of any real data as to the amount of capital required. Reference has already been made to the fact that automation, in particular cases, can be capital-saving. In total, however, automation must mean an increased demand for capital, partly because the automation of a factory or substantial sectors thereof is a comprehensive operation involving the scrapping of much machinery which, under less advanced methods of production, would still have a considerable useful life; and partly because automation implies an increased total output, and hence more machinery is needed to make the increase possible. Any attempt to say which countries are best placed to afford the appropriate rates of capital investment would take me too far into such questions as the rates of saving in different countries and the proportions between productive and non-productive investment. As to the individual firms, it would seem that in general it is the larger firms which are better placed to find the money.'

Automation might also be retarded by the limited size of markets, as it sometimes was required to operate on a large scale to be economical. Mr. Choisy believed that to a great extent this difficulty would be overcome by the European Common Market.

Finally, automation could be hindered by ignorance of its possibilities. Discussing ways in which such ignorance might be at least partially overcome, Mr. Ewing pointed out that: 'there is immense scope for analysis of the economics of automation on an international basis, not simply by a secretariat or specialists but also by organized discussion among responsible officials and industrialists on the basis of facts gathered and case studies carried out in particular countries. In the second place', he continued, 'I consider that the problem of the availability of equipment, and of expanding production capacity for this purpose, should certainly be considered on an all-European basis. If ever there were a case for an attempt towards a certain degree of organized international division of labour, it would, I should have thought, be here. Thirdly, the very fact that there is a need for wider and more stable markets to enable automation to pay gives added importance and perhaps new directions to the work of a body like the Economic Commission for Europe in the field of trade and, in particular, all-European trade.'

INTERNATIONAL ASPECTS OF AUTOMATION

Mr. Ewing's reference to the need for an analysis of automation on an international basis was not a question that was treated separately in any formal meeting of the Study Group. In most of the meetings of the group, however, international aspects of automation were considered. This was inevitable in view of the international composition of the Study Group.

Mr. Levinson, in particular, called attention to the way in which the problems arising from automation might appear in quite different ways in different countries, depending on the level of economic development, the importance of export trade and the strength and orientation of the trade union movement:

'Given this characteristic of universal applicability, automation does not set up a specific type of problem, but it can set up a host of different problems at almost every level depending upon its point of application, the type of economy into which it is introduced and the type of factory and the institutional framework within which the introduction takes place. This may sound somewhat vague. What I mean is that it is extremely difficult to say at the present

time: "That's an automation problem" or "This is the type of thing we're going to be confronted with", because automation can create an almost unending variety of problems that you can't anticipate. How the trade union movement expresses itself on automation also varies from country to country and, in my experience, according to the degree of union organization and the strength of unionism itself. In some areas automation is not a union problem —I'm now speaking in the practical sense, not in the intellectual one of say, an individual who is responsible for following the literature on automation, or looking into one or two cases of it; I'm speaking of it as a practical problem of the trade union in terms of its structure, in terms of its collective bargaining practices, in terms of its demands for economic policy changes on the part of the government, social insurance measures, and what have you. In areas where trade unionism is still relatively underdeveloped, such as Asia and Africa, it is not a concrete problem in that sense. It is less so in countries like Italy and France, for example, where they are fighting to re-establish a trade union structure. The strength of these trade unions is not yet sufficient for them to concern themselves with collective bargaining. Most of their activities are conducted with the object of establishing the institutional strength of the union. Therefore, this type of union, even when it engages in collective bargaining, is merely engaged in it for the purpose of getting publicity in order to enhance its abilities to recruit and to develop institutional strength. The underlying principle is that you have to crawl before you can walk—you have to go through a stage of evolution in growth—and in such cases it is evident that the direct concern with automation is very limited.

'In areas where the trade union movement is already institutionally strong or, let us say, is strong enough for it to concern itself with economic or collective bargaining problems, the experience has been that automation is already a matter of sufficient importance to influence a great deal of collective bargaining. For example, in the U.S.A. basic demands for the oncoming period for a very substantial reduction in working time are certainly related, in the key industries where the demands are being made, to the problem of automation and its development. The automotive industries in the U.S.A. are a case in point. Workers in these industries are demanding the four-day week for 1958—the machinists are going after the 32-hour week, the steel workers are going after the 35-hour week, the electricians are preparing their demands for a very substantial reduction in working time—and it is not accidental that these are the very industries in which automation has made its most rapid progress recently in the U.S.A. So that the direct preoccupation with automation as a trade union problem varies according to the strength of the trade union, and according to whether it can actually deal successfully with the collective bargaining involved. By that I don't want to infer that the problem of automation doesn't exist in other regions—it certainly does—but I think many trade unions are not yet treating the problem in a very concrete sense as something quite distinct from normal union activities.'

Problems of automation may be affected by the position of a country in international trade. As was noted above, one problem arising from automation is the possibility that there will not be enough consumption and investment to absorb rapidly increased production. Although this fear is especially marked in the U.S.A., it is by no means a problem in all countries. In Italy and France, for example, automation is not sufficiently developed to create a problem of over-all demand. In the United Kingdom exports can absorb most of the

increased output from automation. On this point Mr. Levinson noted that: 'Being geared to exports, consumer demand does not present itself as a problem. There you have an incentive to export, stimulated by the Government, stimulated by industry itself, where national consumers' demand plays a lesser part. In fact, there is always an attempt to dampen consumer demand somewhat so as to make more goods available for export. Now in such a case, the problem of automation appears rather as a number of local problems and industry problems, of transfer of certain types of skills, of local pockets of unemployment not geared to the general situation because the demand for the product is high. It is rather a question of retraining or moving people when unemployment does crop up in a given industry as it has in the British automotive industry. Then again, in countries like Italy and France, where automation is much more a characteristic of large plants, you get fully developed automatic processes in big companies like Fiat, Montecattini and Olivetti. This give rise to "pocket" problems, but not to an over-all national problem. These companies are not contributing significantly to the hard core of unemployment that they have in Italy. They are highly profitable and highly monopolistic enterprises, and can take care of their work force in an entirely different way. Here the automation problem is much more a question of making certain that the new techniques don't reduce skills, don't reduce classifications, and in seeing that a just return of the benefits of the firm accrues to the workers.'

As was noted above, however, even if automation raises no problem of over-all demand there may be a problem of transitional unemployment or loss of income security as workers move between jobs. In some countries—Sweden was suggested by Mr. Levinson—institutional arrangements to protect workers from losses due to transitional unemployment are well developed, thus limiting fears or insecurity associated with the development of automation: 'In Sweden, the smallness of the country, the integration of the trade union movement with the party, the influence of those two groups on government policy, coupled with the long-standing practice of State intervention, particularly at the fiscal level, is such that very few people look at automation and come away with the "American" attitude to the problem. Swedish workers are not afraid of unemployment. They have political and other institutional protection. Their social security is good. There, at this particular moment, the problem is that of capital formation, the saving of enough in the other sectors of the community to provide the capital goods and investment facilities necessary for automation to grow. The protective aspect, the anticipating of problems from the workers' point of view, is not only much less important in Sweden than, for example, in England or in the United States of America, but it is also different in kind.'

In the Study Group there was somewhat less discussion of how such automation problems as adjustment to new jobs, shift work and shorter hours of work might differ from one country to another, especially in the case of economically developed countries. It was agreed that this was a field in which more international comparisons might give valuable insight into individual and social problems raised by automation. We need to know how different types of education and social and community organization will make it easier or more difficult for a people to become adjusted to automation. More international comparisons are also needed on types of conflict situations that might arise from automation. One example of how such conflict situations might differ between countries lies in attitudes to job evaluation systems. Mr. Levinson suggested that, at least in the transition to automation, many trade unions

would oppose job evaluation. Such a potential cause of conflict may, however, be much more important in some countries than in others. A recent report of the International Labour Office on job evaluation in the metal trades indicates that it is used more frequently in the U.S.A., Canada and the Federal Republic of Germany than in other countries.[1]

In the discussion on obstacles to automation, opened by Mr. Ewing, it was evident that the barriers standing in the way of automation differed widely from one country to another. With respect to the supply of skilled manpower in different countries, Mr. Ewing pointed out certain contrasts: 'In Western Europe the number of engineers of university degree standard turned out is much the same, with Western Germany perhaps rather better off. There are nearly twice as many turned out in the U.S.A. and nearly four times as many in the U.S.S.R. Moreover, there is no reason to suppose that the quality of those turned out in the U.S.S.R. is lower than in the other industrialized countries.'

There are likewise, even among economically developed countries, differences in production capacity for automation. 'Even in the U.S.A. the capacity of the machine-tool industry, for example, appears to be a limiting factor. This is much more so in the United Kingdom, but apparently, rather less so in Western Germany. In the U.S.S.R. also, machinery capacity is obviously a limiting factor, although the current five-year plan envisages very large increases. There, a fivefold increase in output of automatic equipment by the machine-tool industry is called for (although it is of course difficult to know precisely what is involved); three- and fourfold increases are also called for in instruments, calculating machines and so forth.'

With regard to the possibility that shortages of capital might retard automation, Mr. Kaser believed that there were substantial differences between North America and Western Europe. In North America he believed there was sufficient capital available to finance automation. In Western Europe, however, the greater part of industrial savings is in the form of depreciation allowances. This would be insufficient to permit the replacement of much existing equipment by automation. Extra savings for automation could be obtained by reducing consumption, but most Western European countries 'are welfare states and we have therefore no means of substantially reducing consumption. If one attempts to do so, one no longer has the welfare state'.

The extent to which automation is adopted in a given country may also be affected by the extent to which its industry is integrated. Japan, for example, is highly industrialized in comparison with other Asian Countries and in some fields—notably shipbuilding—it now leads world production. But in many branches of the economy, industrial production is not highly integrated; a great deal of work is subcontracted from large firms to small firms. Under these conditions the 'integration' element of automation would be difficult to introduce without provoking a violent upheaval of small subcontracting units.[2] It may be for this reason that an article in *The Oriental Economist* of June 1957, on 'Japan's Technological Regeneration' does not mention automation.

In the U.S.S.R., on the other hand, the level of integration of industry may

1. ILO, *Job Evaluation in the Metal Trades*, Geneva, 1952. (A report to the Sixth Session of the ILO Metal Trades Committee.)

2. The point that automation will in many cases involve less subcontracting is made in *The American Machinist*, 19 Nov. 1956, p. 105.

be high in relation to its level of industrial development.[1] Some evidence to support this view was presented by David Granick, of Fisk University, to the 1956 meeting of the American Economic Association.[2] One of the reasons suggested by Granick for the development of a high level of integration was that managers of Soviet firms did not consider subcontractors reliable to maintain the quantity or quality of their output:

'Industrial plants have been unable to depend on the reliability of procurement of raw materials and parts from suppliers. This situation has resulted from the fact that Soviet planning in heavy industry has consistently been based on assumptions of maximum production, founded on work-norms and norms of equipment usage better than had yet been actually realized. Purchaser firms receive requisition slips for supplies based on these optimistic assumptions as to future production by the supplying firms. Under these conditions, it has been inevitable that a high percentage of firms (31 to 40 per cent of the total in the economy between 1951 and 1954) should under-fulfil their production plans and thus should be unable to carry out all their contracts for supplying goods to purchasing plants. In addition, the pressure to "fulfil plan", as defined by a single composite index figure for output, has frequently led firms to produce a different product-mix than had been planned for them. This presents no serious sales problem for the producing firms, since it operates in a tight seller's market, but it further complicates the operations of plants dependent for their supplies on these outside producers.

'In view of this institutional "fact of life" of the Soviet economy, arising from the formulation of national plans based on squeezing the maximum possible output from each factory, firms have striven for as much integration as possible with their sources of supply. . . . Managements gain control over their supply problems by minimizing their dependence on others—regardless of the effects on their costs.'

Granick believes that such a high level of integration in Soviet industry prevents sufficient specialization and lowers efficiency; this tendency toward integration may however, make it easier to use automation as the means of modernizing certain types of industry in the future.

The problem of integrating small shops into a large enterprise—which may have to be faced in Japan, for example—might thus be made considerably less difficult. These considerations may constitute one of the reasons why planners in the U.S.S.R. have stressed automation to the extent of setting up a special ministry for automation.[3] Emphasis on automation is also reflected in a Soviet purchasing list for automated equipment presented to the United Kingdom.[4]

The new decentralization policy in the U.S.S.R. might, however, reduce possibilities for automation by reducing the degree of integration or scale of output of some enterprises in the now heavily industrialized areas. On the other hand, the feed-back aspect of automation, along with possibilities for better record keeping by electronic computers, may make decentralization more workable, especially if units are kept reasonably large. In this connexion, Mr. Choisy had remarked to the Study Group that a firm in the State of New York has 43 branch factories and 16 branch laboratories. Each sends automatic

1. There are of course exceptions to this generalization such as the well-known automated Soviet ball-bearing plant described in *The American Machinist*, 14 Jan. 1957, p. 147.
2. See *American Economic Review*, May 1957, pp. 631-42 (especially p. 635).
3. See statement by the U.S.S.R. Minister of Automation in *The Times*, London, 30 August 1956.
4. *Board of Trade Journal*, 11 August 1956.

reports to a central 'electronic brain' which in turn sends out instructions to each branch. With such improved control and communication possibilities automation may have increased chances of success with decentralization.

At its last meeting the Study Group gave particular attention to problems of automation in relation to underdeveloped countries. In these areas of the world—which are here defined to comprise most of Asia (except Japan), Latin America and Eastern and Southern Europe—there is relatively little development of automation. Furthermore, in many cases, it is debatable from an economic point of view whether automation is suitable for poor countries with limited capital, limited markets and serious unemployment and under-employment problems that might be aggravated by the over rapid adoption of automated techniques.

Whether they actually adopt automation themselves or not, underdeveloped countries are bound to be considerably affected by it, at least from a psychological point of view. Greater output from automation in developed countries may mean that the gap in living standards between them and the underdeveloped countries will widen. Automation tends therefore to dramatize and to magnify anxieties concerning already existing aspects of industrialization. Two of these anxiety-producing situations are (a) fear of a widening gap between living standards in developed and underdeveloped countries, and (b) fear of the process of social adjustment to industrialization even though in reality this might be quite different from that involved by the adoption of automation.

The fear of the widening gap in standards of living is accompanied by frustration due to lack of capital needed to raise such standards, even by much less advanced non-automated means, and this has an effect on the thinking of leaders in underdeveloped countries which can hardly be exaggerated. This aspect was already brought to the fore in the discussion of the Director-General's Report to the 1957 International Labour Conference. The same ideas appeared in the July meeting at Geneva of the Economic and Social Council, especially in the discussion of the proposed SUNFED plan for financing economic development. Here it may be interesting to quote from a statement to ECOSOC by Joza Brilej, leader of the Yugoslav delegation:

'The new technological revolution which is now taking place before our eyes will not, of itself, contribute towards a more balanced economic development of the world. Automation and nuclear energy, these two main achievements of contemporary technology, are already being applied in the developed countries on an ever-increasing scale. The increase in the productivity of labour, achieved through the introduction of modern technology, is assuming sometimes overwhelming proportions. . . .

'All this new technology is concentrated in the countries which have already the highest income, the largest capital formation and the highest productivity of labour.

'Automation and modern techniques, which are used in the developed countries, enable these countries to reduce constantly their production costs and at the same time to expand mass production in unheard-of proportions. This obviously places the economies of the countries which are making efforts towards an over-all economic development in an ever more difficult position. This new disadvantage can no longer be met in underdeveloped countries by the old device of pressure on wages.

'In other words, this development of technology is a new element which tends to widen the already existing gap between the developed and under-

developed areas of the world. I do not wish to dwell again upon the impact of this ever-widening gap on the world economy in general and on the economies of the underdeveloped countries in particular.

'This new element impels us to undertake international action, especially in the field of international financing.'

In so far as there is a 'widening gap', it is to a great extent a menace to what modest gains have already been achieved in many underdeveloped countries. From a political point of view, the populations of many such countries are more susceptible to demagogic promises of a better life under a different government if—and this is inevitable with modern communications and the rapid spread of literacy—they see themselves as being outdistanced by the developed countries.

From the economic point of view, careful attention should be given to what Professor Nurkse has called the 'demonstration effect'.[1] With greatly improved communications, people in underdeveloped countries are more aware than formerly of higher standards of living in developed countries. They may try to copy those standards of living. Such attempted emulation may lead to increased spending and less saving in underdeveloped countries. Then even less savings are available for capital formation. Furthermore the demonstration effect may take the form of increased imports from economically developed countries with the result that underdeveloped countries are likely to suffer from chronic balance of payment problems.

To some extent the problems connected with the widening gap can be overcome by international investment and by technical assistance. Dr. Krapf emphasized, however, the point that international investment, especially when it is not internationally administered, smacks of colonialism and if it is sought at all, negotiations are likely to be compromised by a good many restrictions and uncertainties.

With respect to technical assistance, Mr. Kaser suggested that there was a need for a United Nations specialized agency to deal with industrial problems. It seemed inconsistent to him that the United Nations had agencies dealing with such matters as education, health, labour and agriculture but not with industry. Besides research, technical assistance and operations to encourage the financing of economic development which such an agency might undertake, Mr. Kaser believed that it should also deal in junked but still marketable equipment, and in handling machinery which, though obsolete for instance in the U.S.A., might well be shipped from say Minnesota to Bangalore and put into useful operation there.

The second psychological problem raised by automation in underdeveloped countries was then considered. In these areas, as was indicated above, automation is not important in itself, but it tends to bring into sharper focus many of the social problems that are likely to occur in the process of industrialization in underdeveloped countries, whether as a result of automation or otherwise. Dr. Krapf expressed this point as follows: 'It is well known in both theory and practice in psychological medicine that as soon as you are exposed to anxiety you have all sorts of reactions—reactions of regression, of submission and of rebellion against the anxiety-producing agents, behaviour disorders, reactions of flight into artificial paradises, alcoholism, etc. In any case, what you end up with is a new, very much more depersonalized sort of existence, in which you

1. Ragnar Nurkse, *Problems of Capital Formation in Underdeveloped Countries*, Oxford, Basil Blackwell, 1953.

are in a far more passive role, in a far less creative role and this—obviously, not only in the developed countries where industrialization has taken place, but even more in the less-developed countries where the process is relatively new and where its impact is still being felt by people—is anxiety producing. It is quite certain that the differences of attitude towards these questions between people in the highly developed countries and those in the less-developed countries are due to a large extent to the fact that the former have already adjusted themselves—more or less well perhaps—but they have adjusted themselves to those new conditions, while people in countries of recent development have not yet done so. There was, some years ago in Toronto, a study seminar where these problems were being discussed. It was absolutely striking to see how clear was the split between the attitudes of people, say from the U.S.A., who said, "Oh well, all this, really, is of not that much importance—really one must not overdo things", and those from Ceylon, Chili or other countries, who were under the recent impact of incoming industrialization, and who therefore were very clearly aware of the anxiety-producing nature of the industrial revolution and the mental pathology which was also caused by this anxiety.'

One of the main anxieties connected with industrialization in general—of which automation might be called the ultimate stage—is the fear of unemployment. As was noted above, this fear also occurs in economically developed countries. In many underdeveloped countries, however, unemployment—even though it might be transitional from an anlytical point of view—is a much more serious matter than in developed countries because industrial workers, while perhaps poor in absolute terms, are relatively much better off than the chronically unemployed or than those who live by subsistence agriculture. Unemployment then may mean a much greater decline in income and status than in economically developed countries and because of the great numbers of already unemployed, re-employment is likely to take a much longer time.

Because of the immense social consequences of any sudden increase in unemployment especially among a politically conscious urbanized population, there is a strong feeling in some underdeveloped countries, notably India, that industry demanding a high concentration of capital—whether in mechanization or automation—is socially undesirable.

As Mr. Kaser pointed out, this question, at the level of mechanization rather than at that of automation, is something of a burning issue in India. At least at the political level, much is said about the support that the Government is giving to cottage industries in the Second Five-year Plan. Here cottage industries are being encouraged alongside modern industry in order to give more employment, even though some Indian economists would admit at least by implication that more modern industry and less cottage industry would result in a higher level of national income.

It is interesting to note that in the discussion of automation at the International Labour Conference, many of the delegates from underdeveloped countries preferred to discuss this problem of cottage industry versus modern industry rather than to speak about automation *per se*. One interesting middle-of-the-road position on this question was taken by Mr. M. Ismail, an employers' delegate from Pakistan.[1]

1. Provisional Record of the International Labour Conference June 1957, Seventh sitting, pp. 70-2.

'In considering the choice of techniques in underdeveloped countries one is faced with apparent contradictions. Let me give some examples from my country. For the construction of the canals in Lower Sind, or a road between Dacca and Narayangary, modern earth-moving equipment was used. Later it was found that it was very much cheaper to do it by men and donkeys, or by men and bullock cart. It meant a considerable saving for the contractor. For the nation it was even a greater economy, for the contractor's decision had put some under-employed local resources to work and saved valuable foreign exchange which was left free for financing other projects. This is an example where a primitive technique was preferable to a modern one. On the other hand, we can have examples where modern techniques are preferable.

'There is the case of the automatic lathe, for instance. Automatic lathes are available which cost somewhat less than ordinary lathes but which make possible a much larger output. Moreover, several automatic lathes can be fed by one unskilled worker, whereas an ordinary one requires a skilled operator who must be able to read a blueprint and operate the lathe accordingly. In this case we economize not only on capital but also on skilled labour, which again is our most scarce resource. It is clear where our choice lies. The loss in flexibility in using automatic lathes may not prove very material in many cases. But there will be cases in which flexibility is important. Must we go on to a "programme-controlled machine", i.e., automation, in such a case, or back to an ordinary lathe? We cannot answer this question without knowing the difference between the cost of equipment in each case and the wages of the labour employed.

'These examples show that the choice of technique in underdeveloped countries cannot be decided by a simple formula. We cannot support the view of those economists who would have us invariably choose the most labour-intensive technique. Nor would we have any truck with the technologists who want us to adopt the most modern technique regardless of the economic circumstances of the country. Nevertheless, it should be possible for us to clarify some of the considerations which will govern our choice.

'The problem of technological change in underdeveloped countries is, in one respect, fundamentally different from that in the industrially developed countries of the West. In the underdeveloped countries, capital is a very scarce resource and it is vital that we should ensure its most efficient use. In the industrially developed countries the growth of science and the evolution of production technique has taken place against the background of a rapid accumulation of capital and a growing shortage of labour. The techniques now in use in those countries bear some relation to the abundance of capital and the very high cost of labour there. Here we come up against a basic difficulty in choosing the technique which may be appropriate to our circumstances. In choosing a labour-using technique we may in fact be faced with the choice of an outmoded and inefficient technique which had been evolved in the West at a relatively low level of scientific knowledge. Such a technique, by its inefficiency, may in fact involve higher capital cost per unit of output than another which involves a larger capital outlay initially but permits a considerably larger flow of output.

'On the other hand, some of the most modern techniques may prove extravagant in the underdeveloped countries if they have been designed to reduce labour costs regardless of considerably increased capital costs per unit of output. Perhaps our scientists, making full use of the resources of modern science, will

turn to the task of developing new techniques especially suited to the requirements of the underdeveloped countries, which may aim at maximizing the output per unit of capital, even if that involves a somewhat higher labour cost than the techniques in use in the West. In the meantime, we must push on with the techniques that are available and from amongst them we must make our choice. We shall clearly reject all those techniques which are "inefficient", i.e., those which involve not only higher labour costs per unit of output but also higher capital cost. But we shall be left with a range of techniques from which we still must make an economic choice.

'Some theorists proceed from an over-simplified picture of large numbers of under-employed persons in our countries which suggests that the employment of more labour does not represent a social cost. This view is not wholly correct and it can be very misleading when applied as a principle to guide the formulation of a policy.

'First of all, there is the well-known fact that skilled operators are very much in short supply, and this constitutes a serious bottleneck. We must press on with the maximum possible speed with our training programmes, but they will not yield any substantial results for some time to come. In the meantime we must welcome all those aspects of automation which reduce the need for skilled operators.

'Another consideration is one which is generally overlooked in these discussions. In comparing two processes, one of which is more labour-using than the other, we must set off against any direct saving in investment resulting from the choice of the labour-using process the additional investment necessary to house the extra labour and to provide it with the necessary amenities of an urban existence. This must figure in our social accounting regardless of whether this additional investment is undertaken directly by the employer, by other agencies, or by the State. Thus, by the choice of a process using relatively more labour, we would not save as much on the over-all investment as might at first sight appear possible if industrialization involves also a process of urbanization.'

While the main effects of automation on underdeveloped countries have so far been mainly anxiety-producing, it would be wrong to overlook some special advantages which underdeveloped countries have with regard to the introduction and use of automation. The first, and perhaps the most obvious of these is—as was the case in Japan—that a developing country can take over the most advanced technology of a more developed country without having to pay the costs of research and experiment with less efficient techniques. It can jump stages in technological development. As we have already seen, however, such an advantage, if not used in the right way, can become a disadvantage, for instance, when underdeveloped countries slavishly copy techniques that are not suited to their own social and economic environments.

Another advantage that automation may bring to underdeveloped countries is that it may facilitate transition from formal studies to productive work. Under mechanization it was a matter of common knowledge that relatively little could be learned about managing a factory even in advanced academic institutions. Jokes were legion about how little recently graduated engineers knew about managing production. Techniques of production could only be learned on the job and, in fact, many young engineers had an unlearning problem as much as a learning problem because college education was rather strictly 'background' in emphasis and attempts to apply it in too direct a way

were actually discouraged. Such a situation, in which technical training does not fully prepare a man for his job, is serious in an underdeveloped country since that country may not have enough industrial plants to provide on-the-job training facilities for new graduates of colleges or technical institutes. The factory with automation may offer a more direct route for the actual application of training received in a college or technical school. Automation is a more abstract, more generalized approach to production into which the graduate of a largely theoretical curriculum may fit more readily than under mechanization. One point in this connexion was noted by Dr. Walker when he stated that the number of steps in management hierarchies is less than it used to be. Education itself may now be taking over some of these steps. All these tendencies should benefit underdeveloped countries because they represent savings in the tremendous costs of what might be called the machinery required to learn about machinery.

There is one more advantage that automation may bring to underdeveloped countries. It was noted in the Study Group that more and more office work was being automated, and that at the same time factory work was becoming more like work in an office. Witness in the factory, such essentially 'office' paraphernalia as information tapes, punch cards, programming and computers. The modern factory is also cleaner, again more like an office. When we have machines with plastic gears lubricated by water, we may be able to say that offices with their carbon paper and typewriter ribbons are the dirtiest part of a factory. If this distinction between office work and factory work breaks down, it may be of tremendous importance to some underdeveloped countries where prejudice against factory work and in favour of office work is particularly strong and widespread. Along with a surplus of 'educated' candidates for white collar jobs, there is a shortage of skilled workers. Even engineers and managers tend to be 'deskbound' and to find excuses for more paper work in order to keep away from actual production operations. If automation breaks down this office-factory dichotomy and the prejudice in favour of white collar work, it may make it a great deal easier to mobilize talented people for active participation in the work and management of industry.

II. REVIEWS OF DOCUMENTS AND BOOKS

DOCUMENTS AND PUBLICATIONS OF THE UNITED NATIONS AND SPECIALIZED AGENCIES[1]

I. UNITED NATIONS

GENERAL ASSEMBLY

REFUGEES

Facilitation of travel for refugees. Submitted by the High Commissioner. 26 April 1957, 9 pp. including annexes. A/AC.79/74.

[Ej., Pr., Org.][2] This report gives information on the progress made in regard to travel documents and visas and on the agreements concluded between certain countries in this connexion. It is supplemented by an annex concerning an agreement between Belgium and the Netherlands for the abolition of visas for refugees settled in either country.

HUNGARY

Report of the Special Committee on the Problem of Hungary. 12 June 1957, 391 pp. including annex, maps. Provisional version, issued in two volumes in mimeographed form. A/3592.

[Ej., Sc.] Gives the fullest and most accurate information available on the situation brought about by the U.S.S.R.'s intervention in the internal affairs of Hungary and on the course of events as regards the recommendations adopted by the General Assembly.

The introduction gives a brief historical outline of the Hungarian rising and is followed by a chapter describing the rising from the viewpoint of the U.S.S.R. and the Government of Janos Kadar. Thereafter Part A deals with the military intervention and the political background to it while Part B analyses the effects of the use of force on the political independence of Hungary, gives an account of the students' demonstrations from which the armed conflict in Budapest developed and describes the nature of the revolutionary councils and workers' councils, how political rights were restored and what became of those rights after the revolution. Part C quotes examples of violations of other rights of the Hungarian people (notably deportations).

The report is supplemented by an annex containing a list of documents on the Hungarian question and by two interleaved maps.

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1. As a general rule no mention is made of publications and documents which are issued more or less automatically —regular administrative reports, minutes of meetings, etc.
Free translations have been given of the titles of some publications and documents which we were unable to obtain in time in English.
2. For explanation of abbreviations, see p. 134.

NON-SELF-GOVERNING TERRITORIES

Committee on Information from Non-Self-Governing Territories. International collaboration for economic, social, and educational advancement. Note prepared by the Secretariat. 19 April 1956, 18 pp. A/AC.35/L.230.

[Dp., Ej., Pr., Org.] Review of the activities of the Economic and Social Council (nineteenth and twentieth sessions), of the Commission on Human Rights (eleventh and twelfth sessions), the Commission on the Status of Women (ninth and tenth sessions) and the Social Commission (tenth session). The final section contains information on regional co-operation in Africa, the Caribbean, Asia and the Pacific.

Economic conditions and development in non-self-governing territories. Progress of development plans. 18 April 1957, 105 pp. A/AC.35/L.242.

[Dr., Pr., Ej., St.] The purpose of this report by the Secretariat is to describe the present state of development programmes. The report deals with programme changes, objects and the distribution of funds in various parts of the world (Africa, the Caribbean, the Far East, etc.).

Economic conditions and development in non-self-governing territories. The diversification of agricultural production. 1957, 50 pp. A/AC.35/L.243.

[Dp., Pr., Ej.] This report by FAO draws attention to the lack of diversification of agricultural production in non-self-governing territories and goes on to discuss briefly the advantages of diversification, the measures adopted to that end and the progress made. The final chapter gives a summarized recapitulation of the document.

Economic conditions and development in non-self-governing territories. External trade. 3 May 1957, 40 pp. A/AC.35/L.244.

[Ej., Dp., St., Pr.] This report by the Secretariat sets out, in statistical form, the main features of the development of the external trade of the non-self-governing territories between 1953 and 1955.

International technical assistance in non-self-governing territories. 3 July 1957, 77 pp. including annexes. A/AC.55/L.247.

[Dp., Ej., Pr., St.] Part 1 of this report by the Secretariat gives a brief review of technical assistance scheduled for 1956, while Part 2 gives a summary of the programme and projects approved for 1957. Part 3 brings up to date the studies on Jamaica, Federation of Malaya and Nigeria. Numerous annexes containing statistical data.

Activities of the World Health Organization in non-self-governing territories. 18 July 1957, 19 pp. including annex. A/AC.35/L.251.

[Dp., Ej.] This report by the World Health Organization gives a summary of projects in course of execution, and projects still under consideration for 1957-58. Items are arranged according to regions.

Programme of social studies for 1958. 18 July 1957, 8 pp. including annex. A/AC.35/L.252.

[Pr., Org.] The Secretariat here sets out the general principles to be observed in drawing up this programme and gives a model of the type of study to be presented.

Report on economic conditions in non-self-governing territories. 8 August 1957, 42 pp. including annex. A/AC.35/L.262.

[Ej., Pr.] In this report the Sub-Committee on Economic Conditions presents a general picture of the development of the regions under consideration over the past few years and makes suggestions on ways of improving their position (development plans, external trade, industrialization, rural economy, social measures, regional and international co-operation). In an annex, stress is laid on the value of co-operation on the part of the Specialized Agencies of the United Nations.

SOCIAL ASPECTS OF ECONOMIC DEVELOPMENT

Social aspects of economic development. Peasant societies in transition. 8 July 1957, 72 pp. A/AC.35/L.248.
[Ej., Pr.] This report by the Secretariat deals with the problems presented by the transition to a money economy, by the flight from the land and by the countryman's hostility to change.

Social aspects of industrialization in Africa south of the Sahara in rural areas. 12 July 1957, 27 pp. A/AC.35/L.250.
[Ej., Dp., Sc.] This study, prepared by Unesco, gives an account of the evolution of the rural areas of Africa south of the Sahara (rural environments proper, urbanized environments, consequences of the introduction of machinery and the profit motive, emergence of a wage-earning class, changes in housing and way of life, alterations in social, political and economic structures).

ILLITERACY

The eradication of illiteracy. 12 July 1957, 14 pp. A/AC.35/L.249.
[Ej., Dp., St.] In this report Unesco summarizes the action taken by it over the preceding year towards the eradication of illiteracy. The second part of the report gives statistics on the distribution of illiteracy throughout the world.

ECONOMIC AND SOCIAL COUNCIL

NEW POWER SOURCES

New sources of energy and economic development: solar energy, tidal energy, wind energy, geothermic energy, thermal energy of the seas. New York, 1957, printed, 150 pp., $1.25, 5 Sw.fr.
[Ej., Pr., St., Sc.] The object of this report is to consider how the standard of living in underdeveloped regions could be improved by the use of new power sources. The report is in three parts: Part 1 discusses the methods devised for harnessing such forms of energy and their possible role in the generation of electricity; Part 2 contains studies of each of the five potential power sources under consideration; Part 3 contains a bibliography on these problems.

POPULATION

Report of the Population Commission, ninth session, 25 February-8 March 1957. 13 March 1957, 50 pp. including annex. E/2957/Rev.1; E/CN.9/144/Rev.1.
[Org., Pr., Ej.] Following a brief review of the world population situation, the report discusses regional demographic research and training centres, examines the programme for the census of world population in 1960 and recommends a number of projects relating to regional demographic studies. It concludes with the Commission's programme of work for 1957-58.

LEGISLATION ON MARRIAGE, DIVORCE, etc.

Survey of legislation on marriage, divorce and related topics relevant to population. Report by the Secretary-General. 9 March 1956, 292 pp. ST/SOA/29.
[Dp., Pr., Ej.] A summary, covering 24 countries, of the laws regulating certain institutions or practices which may influence population changes (marriage and divorce; contraceptive procedures, abortion and sterilization). The report is based principally on information supplied by the governments of the countries concerned.

Comparative analysis of adoption laws. 27 June 1956, 28 pp., printed, $0.25; 1/9 (stg.); 1 Sw.fr. ST/SOA/30.
[Dp., Pr., Ej., Sc.] This study, intended for jurists and all persons involved in the drafting of adoption laws, gives the results of an analysis of the adoption laws of 13 countries with different legal systems and of disparate social structure (Europe, North America and Latin America).

NATIONAL PRODUCT

Per capita national product of fifty-five countries: 1952-1954. October 1956, $0.15; 1/-(stg.); 0.50 Sw.fr. ST/STAT/SER.E/4.
[Dp., St., Sc.] Statistical tables.

COMMODITIES

Commission on International Commodity Trade, fifth session: Statistical information necessary for the work of the Commission. 21 January 1957, 115 pp. including annexes. E/CN. 13/L.44.
[Dp., Pr., St., Sc.] The statistical data here given relate to the index of prices of commodities exchanged in the course of international trade. Chapter 1 sets out the general principles followed in the calculation of the index, Chapter 2 gives the actual calculations and Chapter 3 lists the commodities in question.

United Nations Conference on Wheat, 1955-1956. Summary of proceedings. 13 December 1956, 39 pp., $0.40; 3/- (stg.); 1.50 Sw. fr. E/CONF.20/5.
[Ej., Org.] Summary record of the meetings of the United Nations Wheat Conference and the text of the agreement resulting therefrom (International Wheat Agreement, 1956).

ECONOMIC SITUATION AND ECONOMIC EXPANSION IN VARIOUS PARTS OF THE WORLD

Economic survey of Latin America, 1956. (Provisional). 7 April 1957, 2 vols., 258 pp. and 108 pp. E/CN.12/427 and E/CN.12/427/Add.1.
[Dp., Ej., St.] The opening chapter gives an account of economic expansion, first in Latin America as a whole, and then in specific countries of the region. Chapters follow on foreign trade, balance of payments, imports, the vulnerability of the Latin American economy and the effect of the crisis in the Near East on supplies of petroleum and petroleum products. In the second volume are chapters on industry, mining, power resources, agriculture and the productivity of the soil.

Study of Inter-Latin American trade. 1956, 313 pp., printed, $3. E/CN.12/369/Rev.1.
[Pr., Dp., Ej., St.] Trade between the various countries of Latin America. Comprehensive picture of the present position.

Note by the Secretariat on the possible repercussions of the European common market on Latin American exports. 15 May 1957, 32 pp. E/CN.12/449.
[Ej., Pr., St.] This note describes the main lines of European integration, explains the situation which would result from the existence of the European common market and suggests the repercussions which that institution might have on the economy of Latin America. Of the two annexes, one discusses the formation of an investment fund for overseas territories, the other contains some statistical data.

*Economic developments in the Middle East, 1955-1956 (*supplement to *World economic survey,* 1956). 1957, printed, 135 pp., $1.50. E/2983-ST/ECA/45.
[Dp., Pr., Ej., St.] The purpose of this report is to give a general idea of the main economic trends in the Middle East. The most important factors which have affected the economic level—capital accretions, investment, agriculture, petroleum and

manufacturing alike—are local in origin. In the appendix are numerous statistical tables relevant to the problems under consideration.

World economic situation. Industrialization in Egypt, Israel and Turkey. Part 1: *Growth and structure of manufacturing industries.* 3 July 1957, 67 pp. including appendix. E/3016.
[Dp., Ej., Pr., St.] This study examines the evolution and physiognomy of industrial undertakings employing 10 workers or more. Chapter 1 outlines industrial development over the last 30 years, and succeeding chapters describes the present situation as regards industrial structure and the relationship of manufacturing industry to national economies as a whole.

A lengthy appendix provides statistical tables.

ASIA AND THE FAR EAST

Report of the Conference of Asian Statisticians, first session. 27 May 1957, 33 pp. including appendices. E/CN/11/456 and E/CN.11/ASTAT/Conf.1/3.
[Dp., Ej., Org., Pr.] Draws attention to the importance of the world survey of agriculture planned by FAO for 1960 and examines, item by item, the programme presented for the various branches of agriculture and the statistical methods to be employed. The appendix contains lists of those attending the conference and of the documents submitted.

Lignite resources of Asia and the Far East, their exploration, exploitation and utilization. October 1956, printed, 134 pp., $1.50; 11/- (stg.); 6.50 Sw.fr. E/CN.11/438.
[Ej., Pr., Dp.] The report begins by detailing the countries of the region in which lignite is found and goes on to describe the methods of lignite location, processing and utilization in those countries. The text is accompanied by illustrations and drawings.

Proceedings of the regional technical conference on water resources in Asia and the Far East. (Flood control series, no. 9.) 1956, 449 pp., $4.50. ST/ECAFE/SER.F/9.
[Dp., Ej., Pr., St., Sc.] Report on the proceedings of the conference held in Tokyo from 17 to 22 May 1954, with texts of papers read by the experts. The conference concentrated more particularly on the economic and social aspect of projects for multiple purpose river basin development, problems of hydrology, selection of types of structure for hydraulic works, sedimentation studies, recent developments in multiple purpose projects, planned utilization of hydraulic resources, factors to be taken into account in river basin development, and hydrological standards.

Multiple purpose river basin development, part 2b. *Water resources in Burma, India and Pakistan. (Flood control series,* no. 11.) 1956, printed, 135 pp.
[Dp., Ej., Pr., St., Sc.] Principal physical and economic characteristics of the countries under consideration. Water resources and present state of their development, in regard to flood control, irrigation and drainage, water power, navigation, and water supply and distribution.

Study of needs and possibilities of development in the future. Numerous maps and statistics.

Economic Commission for Asia and the Far East: Committee on Industry and Natural Resources. Working Party on Small-scale Industries and Handicraft Marketing, Fifth Meeting, 17-24 June 1957, Madras, India.

Promotion and co-ordination of research and experiments on the leather industry in the ECAFE region. 14 May 1957, 56 pp. including appendixes. E/CN.11/I&NR/CIWP/5/L.2.
[Dp., Pr., Ej.] Reviews the various leather and hide research centres and institutes, catalogues the region's resources in raw materials and tanning substances and discusses the manufacture of leather and leather articles in the region.

Some economic aspects of tanning and leather industry. 17 May 1957, 29 pp. E/CN.11/I&NR/CIWP/5/L.3.
[Dp., Pr., Ej.] Gives statistics on the subject.

Needs and problems of trained personnel in the field of small-scale industries. 20 May 1957, 8 pp. E/CN.11/I&NR/CIWP/5/L.4.
[Dp., Pr., Ej.] Draws attention to the need for a rapid increase in the number of skilled workers in the ECAFE region and proffers suggestions on how to bring this about.

Productivity in leather industry. 3 June 1957, 43 pp. including appendixes. E/CN.11/I&NR/CIWP/5/L.5.
[Dp., Pr., Ej.] Concludes that development of the great potentialities of the region is dependent on certain improvements to be effected in three sectors: care of animals, hide preparation and leather-dressing techniques. The report is supplemented by tables and statistics.

United Nations technical assistance in the field of small industries in Asia and the Far East in 1956. 27 May 1957, 5 pp. E/CN.11/I&NR/CIWP/5/L.7.
[Dp., Pr., Ej.] Information on the work of the United Nations Economic Study Missions in a number of countries of Asia and the Far East.

Marketing of hides and skins, leather and leather products. 10 June 1957, 33 pp. E/CN.11/I&NR/CIWP/5/L.9.
[Dp., Pr., Ej.] Traces the development of the trade and indicates measures to be taken.

Economic Commission for Asia and the Far East. Committee on Industry and Natural Resources; Sub-Committee on Iron and Steel, Seventh Session, 3-10 June 1957, Bangkok.

Report of the Sub-Committee on Iron and Steel (seventh session) to the Committee on Industry and Natural Resources. 19 June 1957, 38 pp. including appendixes. E/CN.11/I&NR/1 and E/CN.11/I&NR/Sub. 2/2.
(Pr., Org., Ej., Dp.] Suggests what techniques should be studied on an instructional tour of Europe and reviews the state of the iron and steel industry in Asia and the Far East, steel requirements in that region and the problem of training technical staff.

Appendixes contain the list of those attending the session of the sub-committee and the work programme for the session, with the order of priority adopted.

Steel transforming industries in the ECAFE region. 2 May 1957, 42 pp. E/CN.11/I&NR/Sub.2/L.2.
(Dp., Ej., Pr.] This report concentrates mainly on the position in India and Japan; it traces the development of the steel transforming industries in those countries (plant and finance) and shows their growing importance in the economy.

The report concludes with a bibliography.

Asian steel consumption trends and future demand. 29 April 1957, 68 pp. E/CN.11/I&NR/Sub.2/L.3.
(Dp., Pr., Ej.] The report explains the methods employed by the Economic Commission for Europe to assess steel requirements and prescribe the means to meet these. It goes on to consider how far this experience is valid for ECAFE and lists the countries for which a knowledge of needs and productive potential is necessary. The appendix contains tables showing the steel production position in the countries under consideration.

Re-rollingmills. 2 May 1957, 46 pp. E/CN.11/I&NR/Sub.2/L.4.
[Ej., Dp., Pr.] This report reviews the re-rolling industry in Japan. It also discusses the current problems facing the industry in the Philippines and India.

Iron and steel specifications. Standardization and simplification. 6 May 1957, 45 pp. E/CN.11/I&NR/Sub.2/L.5.
[Ej., Pr.] This study discusses the various types of steel and the advantages of standardizing and simplifying the iron and steel specifications used in the ECAFE region.

Processes of iron manufacture without coking coal and their applicability in ECAFE countries. 8 May 1957, 109 pp. E/CN.11/I&NR/Sub.2/L.6.
[Ej., Pr.] This note by the Secretariat provides information on the utilization of the various types of furnace (charcoal, electric etc.) and analyses the economic aspects of the processes under consideration. A bibliography is included.

Continuous casting of steel. 7 May 1957, 26 pp. E/CN.11/I&NR/Sub.2/L.7.
[Ej., Pr.] List of the major steel industries throughout the world and description of the plant and working processes of some typical factories belonging to three European companies.

Training of technical personnel for the iron and steel industry. 7 May 1957, 76 pp. including appendixes. E/CN.11/I&NR/Sub.2/L.8.
[Dp., Ej., Pr.] Brief information on the methods of training technical personnel used in France, Belgium, Federal Republic of Germany, United Kingdom and United States of America, and an outline of on-the-job training in a Brazilian undertaking and in Chile—living conditions in these last-named countries being considered to approximate to those in the countries with which ECAFE is concerned.

REHABILITATION OF THE PHYSICALLY HANDICAPPED

International social service review (Revue internationale de service social), no. 2, March 1957: *Rehabilitation of the physically handicapped.* v+ 76 pp., printed (sales no. 1957, IV, 4), $0.80; 5/6 (stg.); 3.50 Sw.fr.
[Pr., Ej.] The second number of this review contains articles describing the modern methods of rehabilitation in use for cripples, the deaf, the blind and the dumb. It also contains the international programme for the rehabilitation of the physically handicapped and a bibliography.

TRUSTEESHIP COUNCIL: NON-SELF-GOVERNING TERRITORIES

Committee on the rural economic development of trust territories: study of population, land utilization and land system in Ruanda-Urundi. 26 March 1957, 130 pp. T/AC.36/L.60.
[Ej., Pr.] This document, prepared by the Secretariat, gives, firstly, information on the composition, increase and distribution of the population and, secondly, data on the physical geography and land utilization. A final section describes the land system, the legislation relating to it and its political aspects.

Committee on the rural economic development of trust territories. Summary of population, land utilization and land tenure in the Cameroons under French administration. 19 April 1957, 77 pp. T/AC.36/L.61.
[Ej., Pr., St.] Demographic and economic situation of the territory. Present uses of land. Legislation and principles governing the system of land tenure.

Examination of conditions in the trust territory of the Cameroons under French administration. Agenda item 3(c) (XIX). Note *by the Secretary-General, 6 May 1957.* 21 pp. T/1314.
[Pr., Ej.] This note by the Secretary-General gives the text of Decree No. 57-501 of 16 April 1957, on the status of the Cameroons, as published in the *Journal officiel* of the French Republic of 18 April 1957.

Report of the United Nations Advisory Council for the Trust Territory of Somaliland under Italian administration. 22 April 1957, 138 pp. including annexes. T/1311.
[Ej., Pr., Org.] The report covers the period from 1 April 1956 to 31 March 1957. Chapter 1 describes the internal organization and the functioning of the Advisory Council, while succeeding chapters deal with the political, economic, social and educational situation in Somaliland and the Council's recommendations on it. The annexes contain a list of the correspondence exchanged between the Administering Authority and the Advisory Council and a list of the official statements of the Prime Minister of Somaliland.

SECRETARIAT

Yearbook of the International Law Commission, 1956, 2 vols., 293 and 303 pp., printed (sales nos. 1956 V.3, Vol. I; 1956 V.3, Vol. II.), $3.; 22/6 (stg.); 13 Sw.fr. each. A/CN.4/SER.A/1956 and A/CN.4/SER.A/1956/Add.1.
[Ej., Org., Pr.] Volume 1 gives summary records of the eighth session (23 April-4 July 1956) at which the main subjects dealt with by the Commission were maritime law on the high seas and in territorial waters, considering, among other subjects, the status of shipping, the conservation of useful marine life outside territorial waters and the problems presented by submarine cables and pipelines. The Commission also considered questions arising in connexion with diplomatic relations and immunities and the responsibility of the State.

Volume 2 contains the documents of the eighth session and the final report of the Commission to the General Assembly. It concludes with a list of the other documents not reproduced in the volume which are relevant to the work of the session.

'Refugees'. A UN programme for victims of political, religious or racial persecution. 1956, printed and illustrated, 32 pp., in English only.
[Ej., Org.] This publication, intended for the general public, gives a brief account of the genesis of the United Nations Refugee Fund, provides some useful information in that connexion and presents the programme of aid to refugees: re-education, resettlement in new countries, etc.

United Nations Refugee Fund. Challenge to your conscience: a report to you on refugees. 1956, printed and illustrated, 46 pp., in English only.
[Org., Ej.] This book, written by a well-known journalist and including numerous photographs, gives a summary, for the general public, of the activities of the United Nations Refugee Fund and outlines the present situation with a view to enlisting the moral and practical support of the reader.

II. SPECIALIZED AGENCIES

INTERNATIONAL LABOUR ORGANISATION[1]

RESEARCH BY THE INTERNATIONAL LABOUR OFFICE

The research work of the International Labour Office. 1957, printed, 23 pp., $0.15.
[Ej., Pr.] This article shows how a continuous flow of information to the International Labour Office in large quantities is ensured and how the material received is sorted and analysed there.

1. As a general rule the ILO publications are issued in English, French, Russian and Spanish.

EMPLOYMENT SERVICES AND PLANNING

National employment services, Belgium. 1957, 149 pp., $0.75.
[Ej., Pr.] This study, compiled by the Belgian Ministry of Labour and Social Welfare, outlines the general administrative organization of the services in question and describes in detail their functioning, programmes and methods (national policy on labour placement, information on openings, professional advice, etc.). Numerous tables are provided giving a diagrammatic picture of the organization of various services.

Manpower planning in Norway. 1957, 19 pp., $0.15.
[Ej., Pr.] A booklet showing how the Norwegian authorities have tried to achieve planned employment through a large-scale national development plan covering all the economic and human resources of the country.

VOCATIONAL TRAINING AND TECHNICAL ASSISTANCE

International technical assistance in vocational training. 1957, 19 pp., $0.15.
[Ej., Pr.] This paper gives a brief account of what ILO has done in this field by training native-born instructors under international experts so as to overcome the shortage of skilled workers.

INTERNATIONAL LABOUR CONFERENCE
Fortieth Session (1957)

The fortieth session of the International Labour Conference, Geneva (1957). 1957, 32 pp., $0.15.
[Ej., Pr., Org.] General survey of the proceedings of the session: report on ILO's activities over the years 1947-57, discussion of the Director-General's report, problem of automation, forced labour, execution of Conference decisions. Resolutions.

Forty-first Session (1958)

The reports which follow are preliminary working papers for the proceedings of the forty-first session, to be held in 1958:

General revision of the wages, hours of work and manning (sea) Conventions (revised) 1949 (no. 93), Report II. 1957, 82 pp., $0.60.
[Ej. Pr.] Extracts from the report of the Commission set up by the preparatory conference, the text suggested by the Commission and summary record of the discussion in plenary session of the conference. In an appendix, the full text of Convention No. 93 as revised in 1949.

Engagement of seafarers through regularly established employment offices. Report III. 1957, 13 pp., $0.25.
[Ej., Pr.] Preliminary draft by ILO of an international instrument; summary of the proceedings of the Preparatory Technical Maritime Conference, and draft recommendation adopted by the latter.

Transfer of flag in relation to social conditions and safety. Report IV. 1957, 11 pp., $0.25.
[Ej., Pr.] This report outlines the proceedings of the Preparatory Technical Maritime Conference and incorporates the text of the latter's resolution on flag transfers.

Contents of ship's medicine chests, and medical advice by radio to ships at sea. Report V. 1957, 23 pp., $0.40.
[Ej., Pr.] Preliminary draft for an international instrument by the Preparatory Technical Maritime Conference. Outline of the conference's work and two texts proposed by it reproduced in full.

Jurisdiction over the suspension of officers' certificates of competence. Report VI. 1957, 9 pp., $0.25
[Ej., Pr.] This report deals with the national jurisdictional problems arising in this connexion. The report summarizes the proceedings of the Preparatory Technical Maritime Conference and gives the full text proposed by that conference for the consideration of Member States.

Reciprocal or international recognition of seafarers' national identity cards. Report VII. 1957, 25 pp., $0.40.
[Ej., Pr.] Preliminary draft submitted to the Preparatory Technical Maritime Conference and summary of the latter's proceedings.

Discrimination in the field of employment and occupation. Report IV(1). 1957, 38 pp., $0.25.
[Ej., Pr.] Outline of the work of the fortieth session of the conference on this question and texts of the draft conventions and recommendations submitted. An annex contains a note on the meaning of the terms 'employment' and 'occupation'.

Conditions of employment of plantation workers. Report V(1). 1957, 99 pp., $1.
[Ej., Pr.] Extracts from the report of the ad hoc commission and the conclusions submitted by the commission to the conference. Draft convention and draft recommendation.

Organization of occupational health services in places of employment. Report VI(1). 1957, 58 pp., $0.50.
[Ej., Pr.] This preliminary report, addressed to governments, comprises a general analysis of the whole question, an explanation of the principles on which occupational health services in places of employment should be organized, a survey of the law and practice in the matter in the various countries and a questionnaire.

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

Report of the International Bank for Reconstruction and Development. Agenda item 4 (XXIII). Note by the Secretary-General. 21 Dec. 1956. 1 p. Attachment: *International Bank for Reconstruction and Development. Eleventh annual report 1955/1956 and twelfth annual report 1956/1957.* 1957, 75 and 66 pp., in English only. E/2944.
[Org., Dp., Pr., Ej.] Each report is in two parts, the first of which recounts the activities of the Bank over the past financial year with notes on the progress of projects financed by earlier loans; the second part contains a summary by countries of the year's operations and the usual annexes (annual accounts and annual administrative budget).

INTERNATIONAL MONETARY FUND

Report of the International Monetary Fund. Agenda item 3 (XXIII). Note by the Secretary-General. 21 Dec. 1956. 1 p. Attachment: *International Monetary Fund. Annual reports of the Executive Directors for the fiscal years ending 30 April 1956 and 30 April 1957.* Printed 2 vols., 197 pp. and 211 pp., in English only.
[Org., Ej., Pr., Sc.] These two volumes, each covering one financial year, give outlines of the position as regards international balances of payment throughout the world and the progress of exchanges. They describe the financial and economic situation in the developed and in the less-developed countries in terms of money and revenue, deal with gold reserves and give an account of the utilization of the Fund's resources. Reports on the organization of the Fund and of its financial accounts are annexed.

Report of the International Monetary Fund (1957). 9 pp. E/2945/Add.1.
[Org., Ej., Dp.] Recapitulation of the Fund's main activities between 1 May 1956 and 31 January 1957 (more particularly, use of the Fund's resources and other operations; increase of contributions; modifications in currency exchange systems; technical assistance; training programme and documentation).

UNITED NATIONS FOOD AND AGRICULTURE ORGANIZATION (FAO)

The state of Food and Agriculture 1957. 1957, printed, 171 pp., $2.
[Ej., Pr., Sc., St.] This report shows that, during 1956-57, there was an increase of approximately 3 per cent in agricultural output and trade in agricultural produce. It is noticeable that, in contrast to previous years, the greatest advances have been in the underdeveloped regions. A careful study of the report makes it clear that the essential factor determining family consumption is earnings and demonstrates the significant relationship between general expansion of the economy and improved nutrition. The report contains numerous tables and graphs. The main chapters examine the dietetic and agricultural situation throughout the world and set forth the factors affecting consumption trends and the evolution of the structure of agriculture.

Report of the third regional conference for Asia and the Far East. 1957, printed, 93 pp., $1.
[Dp., Ej., Pr., Org.] Report on the conference held at Bandung between 8 and 19 October 1956. Discusses recent developments in the nutritional and agricultural situation in Asia and the Far East, describes FAO activities and outlines their future course.

Report of the fourth regional conference for Latin America. 1957, printed, 89 pp., $1.
[Dp., Ej., Pr., Org.] Report of the regional conference held at Santiago de Chile between 19 and 30 November 1956. Outlines the present position with regard to agriculture and nutrition in Latin America and states the major problems of that area. FAO's present and future activities are also discussed.

FAO nutrition study No. 15. Calorie requirements. 1957, printed, 67 pp., $0.75.
[Ej., Pr., Sc.] This report by the second committee on calorie requirements represents a further contribution to a programme directed to stating the calorie requirements of human beings in quantitative terms. The report examines the variations in requirements according to activities, body mass, ageing, climate, etc., the standard of reference being a defined 'average man'.

Tree-planting practices in tropical Asia. 1957, printed, 171 pp. $2.
[Pr., Ej., Sc.] Discusses seedings, nurseries and plantations in tropical Asia (with special reference to India, Ceylon, Burma, Thailand, Indo-China, Malaya, Indonesia and the Philippines) and the main characteristics of the species most frequently used in that region. Contains a bibliography.

WORLD HEALTH ORGANIZATION (WHO)

Epidemiological and vital statistics report. 1957, printed, 47 pp., bilingual, English/French, $1.
[St., Sc., Ej.] Statistical tables on maternal mortality and cases of puerperal infection. Annexed are additional statistics on the number of legal abortions in certain countries, on the proportion of hospital births and on variations of fertility with age, followed by a synoptic table.

Chronicle of the World Health Organization, vol. 9, no. 8, August 1957, printed, 28 pp., $0.30.
[Sc., Ej., Pr.] This number contains articles on child nutrition in tropical areas and subtropical areas, on the prevention of insect-borne diseases and on mortality from cancer of the respiratory passages. Also worth noting is an article on the WHO library.

Bulletin of the World Health Organization, printed, vol. 16, nos. 3, 4, 5, pp. 481 to 1082, 1957, vol. 17, no. 1, pp. 1 to 180, 1957, bilingual, $2; 6 Sw.fr. each.
[Sc., Ej.] Contents: Vol. 16, no. 3: Onchocerciasis and filariasis. Vol. 16, no. 4: sanitary engineering and water economy in Europe; pollution and self-purification in sandy

soils; pathogenesis of epileptic and hysterical seizures; critical value of refinements in establishing infant mortality rates; cholera studies. Vol. 16, no. 5: transmissible diseases; typhoid, diphtheria, trachoma, etc. Vol. 17, no. 1: intermediate hosts of schistosoma; cholera studies.

International sanitary regulations. 1957, 129 pp., $1.
[Pr., Ej., St.] Amended text of the International Sanitary Regulations in force at 1 July 1957. The principal purpose of these regulations is to secure maximum protection against the transmission of diseases across frontiers, while keeping to a minimum interference with world exchanges.
Recommendations approved by the World Health Assembly.

UNITED NATIONS CHILDREN'S FUND (Unicef)

Unicef compendium. vol. 6: *1956-1957*, printed, 28 pp., $0.50.
[Ej., Pr., St., Org.] Organization, aims, activities and financing of Unicef. Statistical table on child health and child welfare.

General progress report by the Executive Director: programme developments in Africa, Asia, the Eastern Mediterranean area, Europe and the Americas. 291 pp. in all, 1957. E/ICEF/336, add.3-7/1957.
[Dp., Ej., Pr., Org.] These five addenda provide information on the campaigns undertaken against diseases peculiar to the regions named, on the welfare of mothers and infants and on nutritional programmes.

Guiding principles of Unicef aid. Note by the Executive Director, 27 April 1957. 18 pp. including annexes. E/ICEF/342.
[Pr., Ej., Org.] This note by the Executive Director to the Executive Board of Unicef explains the methods used to evaluate needs, distribute the aid available and co-operate with other organizations. Unicef's activities centre on the problems of child health, nutrition and education. One of its more important tasks is to establish a scale of relative urgency. Part 2 of the note deals with field activities. The note concludes with a discussion of Unicef's role in the future.

Countries and programmes assisted by Unicef. A count and listing of countries and territories and programmes assisted by Unicef at the time of the conclusion of the April 1957 session of the Executive Board. 14 May 1957, 36 pp. E/ICEF/343.
[Org., Pr., Ej., St.] This report lists the countries which have received assistance through Unicef and the programmes carried out and presents an over-all picture of how Unicef aid was spread between maternal and child welfare, disease control, diet, and emergency aid, at the end of the April 1957 session of the Executive Board. Synoptic tables are included in the report.

Review of maternal and child health activities and related training of professional and auxiliary health workers. Presented by the WHO Secretariat to the tenth session of the Unicef-WHO Joint Committee on Health Policy, 2-3 May 1957. 22 May 1957. 68 pp., also issued as document WHO/MCH/64. E/ICEF/347.
[Ej., Pr., St.] This study furnishes examples to illustrate various types of programme—from the simplest to the most complex—the general objectives remaining in every instance the same. It is backed by numerous statistics.

UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION (Unesco)

ACTIVITIES OF UNESCO

Approved budget and work plans for 1957-1958. 1957, 189 pp.
[Org., Pr.] A reference document for all those who will be concerned with the conduct of any work in connexion with Unesco's programme for 1957-58: resolutions adopted by the ninth session of the General Conference, detailed plans for the execution of those decisions and the related budget estimates.

Conference manual. Revised edition issued after the ninth session of the General Conference, New Delhi, 1956. 1957. 66 pp., printed.
[Org.] This manual contains the Constitution establishing Unesco and brings the regulations under which the Organization functions, particulars of agreements passed with the United Nations, etc., up to date.

COMENIUS

John Amos Comenius: 1592-1670. Selections. Introduction by Jean Piaget. 183 pp., $3.25; 16/- (stg.); 1,000 Fr.fr.
[Sc., Ej.] Volume issued in connexion with the third centenary of the publication of Comenius' complete works in the Netherlands, in 1657. Extracts from the works of the great educator, who was one of the first to preach the ideas on which Unesco has worked since its foundation. Jean Piaget's introduction makes a close examination of the relationship between Comenius' thought and that of modern specialists in the field. It seeks to bring out the originality of Comenius' educational ideas and goes on to compare them with the thinking of twentieth-century experts. Summaries and bibliography supplied by the Comenius Institute of Prague.

CULTURAL AND EDUCATIONAL STATISTICS

Draft manual of educational statistics. 1957, 25 pp. Unesco/ST/R/17.
[Pr.] A draft manual prepared for a meeting of experts to take place in 1958. Suggestions on the definitions and classifications which should be adopted to secure cultural and educational statistics susceptible of comparison internationally.

ILLITERACY

World illiteracy at mid-century. Statistical study. 200 pp., printed, $2; 10/- (stg.); 500 Fr.fr.
[Ej., Sc., St., Dp.] A first world return of illiteracy; number of illiterates in individual countries; problems involved in their numerical assessment; analysis of the case of the major zones of illiteracy; illiteracy and percentage of school attendance; illiteracy and national income; illiteracy, agricultural recession and industrialization. Map.

REVIEW OF THE PRESENT STATE OF AMERICAN SOCIAL PSYCHOLOGY AND ITS PRACTICAL APPLICATIONS

Some applications of behavioural research. General editors Rensis Likert and Samuel P. Hayes, Jr. 1957, 333 pp., printed, $3.25; 16/- (stg.); 800 Fr.fr.
[Ej. St.] Published as one of a series seeking to show the practical implications of the scientific advances achieved in the various fields of economic and social science. Adopting this standpoint, the volume under consideration describes the contribution made by the science of social behaviour with particular reference to the United States of America: knowledge of group dynamics, of processes of communication, of how decisions are arrived at, etc., and calculated intervention to steer these phenomena. Numerous examples.

SOCIOLOGICAL STUDY OF ECONOMIC AND SOCIAL EXPANSION IN PAKISTAN

HUSAIN, A. F. A. *Human and social impact of technological change in Pakistan.* Report on an inquiry by Dacca University published with Unesco's co-operation. Pakistan, Oxford University Press, 1956, 2 vols., 404 and 344 pp., printed.

[Sc., St.] Detailed studies of the economic, psychological and social implications of the increase of factories in an area such as East Pakistan: method adopted; economic, social and cultural background; reaction and attitudes of workers and employers to technological changes and to their new occupations; the effects of those changes on the life of the community. General remarks and specific data yielded by direct observation in factories and by samplings of groups at different stages of the process whereby populations of archaic type are absorbed into the culture characteristic of industrial communities. The second volume deals in detail with a number of individual cases.

EXPLANATION OF ABBREVIATIONS USED

Dp. = Presents facts country by country (or region by region).
Ej. = Supplies essential information to educators and journalists interested in social questions.
Org. = Is very useful for knowledge of the current activities of the international organization concerned.
Pr. = Supplies useful factual information for certain groups of people (educators, government officials, members of international organizations and social institutions, etc.) whose activities are connected with the subject-matter of the document.
St. = Contains statistics.
Sc. = Deserves the attention of scientific workers in the field concerned.

The importance of these conventional signs is, of course, purely relative, and we do not wish their use to be taken as implying a system of classification. We use them merely in order to give as brief an abstract as is consistent with indicating, in the easiest way possible, that part of the contents of the publications and documents under review which relates to somes particular branch of social science.

BOOK REVIEWS

Beginning with the present issue, the International Social Science Bulletin *resumes, in a new form, the publication of book reviews which was interrupted about a year ago. The book reviews will no longer be limited to works dealing with international organization, but an attempt will be made to report on any particularly important books published in the field of the social sciences during the preceding months. This policy presents the editors of the book reviews with two difficulties which must be carefully defined and understood.*

The first is due to the increasingly wide range of studies coming under the term 'social sciences', and to the fact that it is thus obviously impossible to cover the whole field. For the purposes of these book reviews, therefore, priority will be given to the analysis of the most general works, excluding those—whatever their intrinsic value— which deal only with a narrowly defined subject and relate only to a particular technique or speciality.

The second difficulty is connected with the question of what is to be regarded as 'important', since a selection of 'important' works is necessarily, at least to some extent, a matter of individual opinion. In order to overcome this difficulty as far as possible, the selection of the books to be reviewed has been entrusted to a specialized international organization particularly well qualified for the task, the

International Committee for Social Sciences Documentation. Every three months this organization, after consulting all its members and hearing the views of a sub-committee specially set up for the purpose, will draw up a list of the works to be reviewed. Plans for consulting international social science organizations have also been prepared. Any suggestions from readers, authors and publishers will be gratefully received. The committee will obviously be unable to include all the works sent to it or brought to its notice, but all these works will at least be mentioned in the indicative list of works received, which will come at the end of the book reviews section.

The small number of books reviewed in the present issue represents only a first and still very limited selection. As from the next issue of the Bulletin, *the selection will be larger, covering more countries and subjects, observing more closely defined criteria and taking into account whatever comments may have been prompted by this first list.*

The reviews themselves will be analytical and objective, avoiding any controversial discussion, but they will be designed to indicate why the book is important and the reasons for including it in the list.

Correspondence concerning the book reviews, and any works which publishers or authors wish to have reviewed, should be addressed to the Editor of the Bulletin, *Department of Social Sciences, Unesco, 19 Avenue Kléber, Paris-16e.*

BECKER, H.; BOSKOFF, A. eds. *Modern sociological theory in continuity and change*. New York, The Dryden Press, 1957, xiii + 756 pp.

Without wishing to prejudge the future trends of sociological theory, the 26 authors who have contributed to this publication have sought to clarify present tendencies, with special emphasis on continuity and change. The book deals mainly with the last 10 years, but the authors give numerous references by which the various tendencies can be linked up with the preceding period. An introductory section emphasizes, in particular, the transition from 'social thought' to 'sociological theory' and determines the extent to which modern sociology constitutes a new conception of social life. These efforts to evaluate the significance of sociological theory over a period of time are continued in the second part of the book, in which the authors, after a few chapters on the evolution of sociological theory—reflected, for instance, in the prominence given, at various times, to the concept of value—proceed to study the question of methods.

General methodology, processes and techniques are dealt with in a chapter which throws considerable light on the trend of research that is generally concerned with the quantification of social phenomena. On a parallel plane, an important place is also given to structural and functional analysis, while developments in theory are considered in conjunction with the problem of social change. In the third part, certain fields, corresponding to special branches of modern sociology, are discussed separately: study of small groups, social disorganization and stratification; sociology of knowledge, law, religion, art. The fourth part defines the relations between sociology and certain neighbouring disciplines, such as cultural anthropology, social psychology and psychoanalysis, while the last part describes research trends in Great Britain, France, Germany, Italy and Japan, thus providing additional information necessary to complete the picture of sociological theory, as it is conceived particularly in the United States of America.

CALVEZ, Jean-Yves, S.J. *La pensée de Karl Marx*. Paris, Editions du Seuil, 1956, 664 pp.

Despite the differences of opinion regarding nearly every aspect of Marx's thought, both critics and admirers are today agreed as to the importance of his work. The amount of scholarly research on Marxism has notably increased in recent years. It may safely be affirmed, however, that few writers, whether they be partisans or adversaries of Marx, have made as massive a contribution to the knowledge of his work as has Father Calvez.

As Father Calvez points out himself in his introduction, it is impossible to write a book on a doctrine such as that of Marx, which is above all a 'theory of action', without making clear one's own position. Ah the same time, he considers it possible to maintain a certain form of objectivity. While non-Catholics in general, and Marxists in particular, will not be able to accept many of the judgements expressed by Father Calvez in the course of his analysis, even though he may consider these criticisms as 'immanent in the very development of Marx's thought', few will question the scrupulous honesty with which

he distinguishes his own comments and reflections from his exposition of the ideas of Marx.

The usefulness of this volume to those who do not share the political or philosophical views of the author is further increased by the arrangement. Over 550 pages out of a total of 620 pages of text are devoted to a systematic presentation of the ideas of Marx, interrupted only very rarely by critical comments. These scattered remarks are then brought together and elaborated in the concluding section.

Like all students of Marx, Father Calvez emphasizes that Marxism is not a speculative philosophy of the usual kind, inasmuch as Marx considers intellectual activity to be a form of alienation if it is not related in some way to revolutionary action. 'The philosophers have only interpreted the world in various fashions', wrote Marx in his *Theses on Feuerbach*, 'what is required is to change it'. At the same time, the author considers that Marx's work is essentially philosophical in nature. 'On the economic plane', he writes (p. 319) 'just as on the religious, ideological and political planes, we remain at a level at which the total significance of man is involved. It is precisely this plane of research which is called philosophy.'

Father Calvez's presentation of Marxism falls logically into three divisions, devoted respectively to Marx's analysis of alienations (religious, philosophical, political and economic), to the dialectical character of his philosophy, and to the theory of the revolution. The first is the least controversial, and should be appreciated by readers of every tendency for its precision and finesse. The second is marked by the author's insistence on the unity of what is commonly called dialectical and historical materialism, which the author regards as simply aspects of a single dialectical method, and by no means distinct stages in the evolution of Marx's thought. Father Calvez is critical both of the Leninist interpretation of Marxism, which in his opinion exaggerates the autonomy of the superstructure in the historical process, and of the revisionists, whom he considers to have rejected historical determinism too hastily, without properly appreciating the flexibility of Marx's conceptions on this subject. It is, as may be imagined, in the third section, dealing with the end of 'prehistory' and the establishment of a communist society, that Father Calvez's own opinions are most clearly visible and come into sharpest conflict with those of Marx. He considers that such a theory, implying the complete absence of negative moments in the evolution of post-revolutionary society, is in contradiction with the premises of Marx's own dialectical concept of history. At the same time, he must, of course, as a Christian, reject Marx's naturalism, i.e., the claim that the total significance of human existence can be realized by a more perfect adaptation to, and mastery of, the natural world.

KOMAROVSKY, M. ed. *Common frontiers of the social sciences*. Glencoe, Ill., The Free Press and The Falcon's Wing Press, 1957, vii + 440 pp.

Although the common frontiers of anthropology, social psychology and sociology have been explored many times, those of economics, sociology and history have hardly been studied at all, except during very recent times. The various contributors to this collective work try to remedy this omission. The method employed is a novel one: instead of making a general study from the point of view of each of these disciplines, the authors endeavour to indicate their interrelations in connexion with particular problems which can be studied only by an interdisciplinary approach. Media of information, electoral data and public opinion are thus found to be particularly suitable fields of research for anyone wishing to show how sociology and history, or more precisely historiography and empirical sociological research, can assist each other. Similarly, business studies, connected with the theory of firms, and forming part of industrial sociology, show the links between economics and sociology. These links can, incidentally, be seen equally well if we endeavour to determine the social or psychological premises of Keynes' theory of cycles, if we assess the use of survey methods in the economic field, or if we study the behaviour of trade unions in the light of group sociology. No doubt the various problems considered, despite their importance, are not sufficient to enable us to explore the whole of the frontier areas between history, sociology and economics; but they are comprehensive enough to show that these frontiers are not absolute and that

the possibility of crossing them constitutes for each discipline the surest means of attaining its object.

MILLS, C. Wright. *The power elite*. New York, Oxford University Press, 1956, 423 pp. At the beginning of this study Professor Mills defines the 'power elite' as those who 'are in positions to make decisions having major consequences'. The task which he sets himself is to study the composition of those groups which wield major political, economic and military power in the United States, in order to determine on the one hand the social origins of those who occupy dominant positions in any field, and on the other hand the relations between the various elites.

His method is to compile a list of all those who have been members of a particular elite, objectively defined, and to study the biographies of all the individuals involved in order to discover common characteristics and changes with time. The most important groups studied are the economic elites (one group consisting of some 300 Americans who have possessed a personal fortune of at least 30 million dollars, as indicated by available evidence, and another group of executives of the major corporations) and the political elite, consisting of all those who have been members of the Supreme Court or who have occupied the Presidency or certain other important posts in the United States political system.

With regard to the origins of these elites, Professor Mills' conclusion is that social mobility in the United States is much lower than commonly supposed, and is regularly decreasing.

Perhaps even more striking, and certainly more controversial, are his conclusions regarding the relations between the various elites. As far as the structure of the economy is concerned, he utterly rejects the theory that a 'managerial revolution' has deprived the very rich of all real power. In his opinion, there has occurred a fusion of the managerial and propertied groups to form the 'more or less unified stratum of the corporate rich'. Moreover, this new economic elite has come to be practically identical with the political elite.

On the basis of these conclusions, Professor Mills presents some reflections on what he calls the 'theory of balance': the theory that liberty is assured in a capitalist society because there are two distinct centres of power, one economic and the other political, which act has a check on one another. He considers this theory to be in contradiction with the facts regarding present day American society. In his view, political decisions, which in de Tocqueville's time were the result of the spontaneous interplay of independent forces, are today made by the members of the 'power elite' occupying important positions in the executive branch of the government, after consultation with other members of the 'power elite' representing the corporate world; the elected officials in the 'middle levels of power', such as the members of Congress, enjoy little real influence.

As Professor Mills himself indicates, it is extremely difficult to obtain documentary information regarding the top levels of American society. Because of this, and because of the very vigorous and sometimes combative language in which he presents his argument, it is not to be expected that his conclusions will command universal agreement. There is, however, no doubt that he has collected and analysed a mass of very interesting data, which should provide material for reflection not only for those concerned with the study of American society, but also for all those interested in political theory.

SORRE, M. *Rencontres de la géographie et de la sociologie*. Paris, M. Rivière, 1957, 216 pp. To maintain that the sciences of man are one and indivisible, in the sense that man himself is an indivisible entity, completely involved in each of his acts, does not rule out the possibility of approaching the various sciences from a number of different standpoints in order to obtain a more complete picture of them. The relations between human geography and sociology show the difference in the views which these two sciences give of the inhabited earth; but, far from resulting in opposition, this difference, which is so obvious when we refer to the history of the two sciences and to their respective definitions, prepares the ground for co-operation between them: geography brings all its resources to bear on the study of the material constituents of the sub-stratum underlying

society and sociology, working from within, gives us a deeper understanding of the adaptation of human groups to the natural environment. The complementary nature of the two sciences will be appreciated if we analyse the concepts common to both of them (permanence and mobility, space); it is also shown in the importance which both attribute to ecological considerations. The geographer and the sociologist are equally interested in the question of the relations between living beings and their environment. No doubt the geographer tends first to define the environment, and is liable to try to explain the group as resulting from it, whereas the sociologist concentrates rather on scientific description of the group and then considers the mesological and other influences which may explain it; but these two methods of studying the same problem are complementary rather than mutually exclusive. The interpenetration of sociology and geography is also to be seen in fields opened up to research during the last 20 or 30 years, namely religious, political (particularly electoral), and urban activities, and is becoming more marked in the case of the problems raised by the speeding up of technical progress. Thus, in general, the study conducted by the author of this bookoffers particularly good evidence of the unity of the sciences of man.

WEIL, Eric. *Philosophie politique*. Paris, J. Vrin, 1956, 263 pp.

This book is the fruit of some of the most important thinking done during recent years on man as a member of the community and on the significance of the State and the future world organization for the individual. It is clear, however, that this study does not fall under the heading of the social sciences; in the preface itself, the author warns the reader that he will be disappointed if he expects to find in his book information and general conclusions, or knowledge and techniques, such as can be provided by so-called scientific thought applied to social phenomena. The present work is thus strictly philosophical in nature, and the author indeed stresses the point that political philosophy is only a part of a whole and can ultimately be understood only if it is considered in relation to a philosophical system in its entirety. The book is nevertheless of great interest from the point of view of the social sciences; the latter, for instance, have already been strongly influenced by Hegelian thought, on which Eric Weil has written commentaries and which also provides the starting point of the present study.

After defining politics as the 'thinking out of reasonable action', and thus distinguishing it both from ethics and from the social sciences (a term which he uses to cover 'theoretical sociology and, as its main constituent so far as the analysis of social machinery is concerned, political economy'), Eric Weil concentrates his attention on the State, regarded mainly as a rational organization (creating the possibility of a reasonable life for everyone, and considered as such by all) rather than as a coercive organization. He considers the modern State to be primarily a legal State, established and given form by universal, formal laws whose characteristic is that they apply in the same way to all citizens; this is itself a direct consequence of the nature of modern society. It is, in fact, the historical form of the struggle with the natural environment that necessitates equality, i.e., the use of all available human forces, and legal formalism, i.e., the possibility of working out the issue of all the disputes likely to arise between those playing a part in society. The different types of modern State, the author goes on, are distinguished by the methods used by the governments for deliberating and taking decisions, rather than by their respective legal systems. The government is autocratic when it acts by itself, without the need for any action on the part of other organs. It is constitutional when it is bound to observe legal rules which limit its freedom of action; observance of the law is ensured by the independence of the courts and by the participation of the citizens in the work of legislation. Parliament expresses the wishes and moral principles of the community as distinct from the rational and reasonable action of the government; it therefore enables the latter to educate the people. This work of education is an essential condition for the existence of the modern constitutional State: the latter 'cannot last where modern society does not yet exist'. Thus, the main task of a reasonable government is to educate. The education of the governors and the governed makes it possible to reach decisions which are both understandable and acceptable to all, thanks to 'give and take' between a government which proposes and public opinion which accepts

(or refuses). The reasonable freedom of the citizens is the aim of politics and the government's efforts must be directed to promoting it.

Lastly, Eric Weil analyses the relations between States. He immediately comes up against the historical contradiction between the contemporary world, in which individual States are opposed to one another, and the world community—universal and peaceable—postulated by the reasonable character of the State. It is true that 'violence has been, and still is, the motive power of history'; but, from the political standpoint, the trend of history is characterized by progress towards non-violence. It is true that the nature of international relations is marked by the ever-present possibility of armed conflict; but a society which reasons and calculates is essentially a peaceful society. The solution of this contradiction is therefore in sight, by way of the voluntary establishment of an organized world society, respecting individual communities. This is the way to a solution of the modern political problem, defined as 'the reconciling of the various moral systems resulting from history with the world-wide organization of the struggle with the natural environment', the final aim of this organization being 'the satisfaction of the needs of reasonable individuals belonging to free individual States'.

This is in no way meant to be a prophecy and Eric Weil denies any intention of defining in advance the successive forms that international organization will take; theory can do no more than propound a theoretical truth, which, in the present case, is a possibility at last open to the modern world. In any case, it would seem that no theorist concerned with political science and social science can afford to ignore the analysis contained in this book.

WOOTTON, Barbara. *The social foundations of wage policy*. London, Allen and Unwin, 1955, 200 pp.

Defining wages as the price of labour, classical theory was prepared to accept a tendency towards the equalization of the price of labour as all other prices, and endeavoured to explain existing differences in wages by differences in the marginal products of wage earners. This explanation of the wage system—however subtly it may be developed—implies that the trade unions play no part in the raising of the workers' standard of living and that they are responsible for unemployment; furthermore, it gives no explanation whatever of a certain number of cases of abnormal wages. A careful study of the British wage pattern leads the author to maintain that departures from the norm are the rule and that this situation cannot be explained by economic considerations. Economists must therefore admit that the wage pattern is the result of a long and complex interaction of social as well as economic forces, and that it reflects not only certain contemporary economic arrangements, but also custom and judgements concerning the relative dignity of the various classes and professions. The progress and extension of trade unionism and collective bargaining, the intervention of the public authorities through the institution of wage policies, mediation and arbitration do, however, result in an increasing rigidity of the wage pattern and a tendency to perpetuate the existing situation. In fact, each group puts forward the injustice of its own fate as an argument against any change, and those responsible for wage policies yield to moral arguments in a field in which it is difficult to express ethical problems in satisfactory terms. The author strongly recommends a policy with a deliberate bias towards the equalization of incomes: under a rational system of this kind, exceptions to the rule should be justified by explicit economic considerations.

BOOKS RECEIVED, SHORTER NOTICES

Annales de la Faculté de droit d'Istanbul. Sixth year, no. 7, 1957. Istanbul, Fakülteler Matbaasi, 1957. 4to, 851 pp.
Articles on various legal subjects; numerous texts concerning the international civil service (in particular, the decisions of the Administrative Tribunals of the International Labour Organisation and of the United Nations) with comments and an important analytical index.

BALLVE, F. *L'économie vivante. Son histoire et ses mécanismes.* Translated from the Spanish by Raoul Audouin. Preface by P. Lhoste-Lachaume. Paris, Sedif, 1957. 12mo, 176 pp., 360 Fr.fr.
Description of the options which determine the orientation of the modern State; the central idea of this work is that protectionist reflexes, illusions concerning equality, and the ambitions of planners prevent the normal economic process from producing results.

BASU, Saroj Kumar. *A survey of contemporary banking trends . . .* Calcutta, The Book Exchange, 1957. 8vo, xii + 574 pp., bibliography, 16 rupees.
A comparative study of recent trends in banking practice and legislation: central banks, credit institutions, international financial institutions.

BEALS, Ralph L.; HUMPHREY, Norman D. *No frontier to learning.* The Mexican student in the United States of America, by Ralph L. Beals and Norman D. Humphrey, assisted by Ralph Arellano, Agnes Babcock and Louis Stone. Minneapolis, University of Minnesota Press, 1957. 8vo, xiv + 148 pp., $3.25.
Social and intellectual aspects of the Mexican character; results, at the individual and national levels, of a lengthy stay by Mexican students in the United States of America.

BORRIE, W. D.; DEDMAN, Ruth M. *University enrolments in Australia. 1955-1970.* A projection by W. D. Borrie and Ruth M. Dedman. Canberra, The Australian National University, 1957. 8vo, 20 pp. (*The Australian National University. Social sciences monographs*, 10.)
The steady increase of the population and immigration create serious problems for Australian universities, which are already overcrowded. Charts and statistics concerning the student population.

CALDERAN BELTRAO, Pédro. *Vers une politique de bien-être familial.* Éléments d'une normative économique et sociale de la politique familiale. Preface by Mr. Yves Urbain. Rome, Librairie éditrice de l'Université grégorienne; Louvain, Institut de recherches économiques et sociales, Université de Louvain, 1957. 8vo, 347 pp., fig., bibliography, 1,500 lire. (*Studia socialia edita ab Instituto scientiarum socialium Pontificiae Universitatis Gregorianae*, 2.)
Inquiry into the economic and social elements of a doctrine of family policy. Origins, principles and effects of this policy.

CAVALLI, Luciano. *Inchiesta sugli abituri.* Preface by Gianni Baget-Bozzo. Genova, Grafici S.A.G.A. Reale, 1957. 8vo., xvi + 112 pp. (*Le Inchieste dell'Ufficio studi sociali e del lavoro comune di Genova*, no. 1.)
Results of a survey carried out at the beginning of 1957 in the 'zone' surrounding the city of Genoa: living and housing conditions, effects of migration (particularly from southern Italy), social consequences, prospects of the campaign against slums.

DIETERLEN, Pierre. *L'investissement.* Observations de Tibor Scitovsky et Jacques Peyrega. Bibliography by Claude Zarka. Paris, M. Rivière, 1957. 8vo, 362 pp., bibliography. (*Bilans de la connaissance économique*. Collection under the direction of Robert Mossé, no. 6)

This book, which reflects the author's personal views, examines present-day knowledge about investments and indicates the gaps in that knowledge. The 'observations' which follow the main part of the work clarify and complete it; the bibliography lists only a small number of titles (44), but gives a substantial summary of each of the articles and works mentioned.

Egypt. George L. Harris, research chairman and editor. Contributors: Moukhtar Ani, John A. Cookson, Sheila C. Gillen, George A. Lipsky. . . . New Haven, Human Relations Area Files, 1957. 8vo, xii + 394 pp., bibliography. *(Country survey series.)*
A comprehensive work containing abundant data relating to modern Egypt: history, geography, population, political régime, economic system, finance, public health, education, religion, ways of life, etc., well documented and with a very full bibliography.

Fédération Internationale des Industries Textiles Cotonnières et Connexes. *La disponibilité de coton brut en Europe occidentale.* Manchester, Fédération Internationale des Industries Textiles Cotonnières et Connexes, 1957. 8vo, 24 pp.
The unequal opportunities of the various European cotton industries to obtain raw materials; their causes, nature and extent.

Fourastié, Jean. *Productivity, prices and wages . . . Project no. 235.* Paris, The European Productivity Agency of the Organization for European Economic Co-operation, 1957. 8vo, 116 pp.
The indirect method which the author suggests for measuring productivity, based on the assumption that prices and wages are determined solely by the degree of technical progress, represents a novel approach to the subject.

Gordon, Margaret S.; Amerson, Ralph W. *Unemployment insurance.* Edited by Irving Bernstein. Berkeley, University of California, Institute of Industrial Relations, 1957. 12mo, xii + 87 pp., bibliography, $0.50.
Description of the present system of unemployment insurance in the United States of America; its complexity is the inevitable result of the fact that it is partly federal and partly local in character.

Gowman, Alan G. *The war blind in American social structure.* New York, American Foundation for the Blind, 1957. 8vo, xviii + 237 pp., bibliography.
A detailed analysis of the psychological and sociological obstacles to social integration of the blind.

Heckscher, Gunnar. *The study of comparative government and politics.* With a preface by William A. Robson, London, Allen and Unwin, 1957. 8vo, 175 pp., 18/- (stg.).
A general report on the round-table discussion of the International Political Science Association (Florence, 1954): general methodological problems, applications of the comparative method to particular branches of study.

Hewitt, A. R. *Guide to resources for Commonwealth studies in London, Oxford and Cambridge.* With bibliographical and other information. London, University of London, The Athlone Press, 1957. 8vo, viii + 219 pp., bibliography, 21/- (stg.).
A very useful guide (excellently arranged and presented) to all the resources available to advanced students wishing to study at the universities of London, Oxford or Cambridge, problems relating to the British Commonwealth, particularly from the points of view of history and the social sciences.

Husain, A. F. A. *Human and social impact of technological change in Pakistan.* A report on a survey conducted by the University of Dacca and published with the assistance of Unesco. Vol. I-Vol. II. *Reports of case studies.* London, Oxford University Press, 1956. 2 vols., 12mo, xxii + 404 pp., viii + 344 pp.
This vast survey of the impact of industrialization in Pakistan carried out by the University of Dacca assumes particular importance in view of the fact that it deals

with conditions in a Moslem country. Volume I presents the conclusions of the survey; Volume II contains 73 reports of interviews indicating, in general, that many traditional attitudes still persist.

INSTITUTO COLOMBIANO DE SOCIOLOGIA. *Ponencias, documentos y recomendaciones del primer seminario colombiano sobre la enseñanza de las ciencias sociales en el nivel universitario.* Bogotá 2-7 July 1956. Bogotá, Empresa Nacional de Publicationes, 1957. 8vo, 214 pp. (Fondo universitario nacional. Instituto colombiano de sociología. Serie *Reforma universitaria.*)
The numerous texts in this publication deal with general problems relating to the social sciences, their teaching and their specific characteristics in Colombia and in Latin America.

LANDHERR, B. *Social functions of libraries.* New York, The Scarecrow Press, 1957. 8vo, 287 pp., bibliography.
In this book, the librarian of the Peace Palace at The Hague, who is also an experienced international sociologist, studies libraries as social institutions and considers their functions, usefulness and limitations as well as their place in the cultural history of mankind.

LUDWIG, Mario. *Internationale Rohstoffpolitik.* Zurich, Polygraphischer Verlag, 1957. 8vo, 128 pp., bibliography.
The development of specific policies with regard to raw materials has become an important aspect of world economic policy. The present work discusses the historical causes of this trend, and various international agreements; it concludes with a critical study of early results and future prospects.

MAZZOCCHI, Giancarlo. *Risparmio e ciclo economico.* Con particolare riguardo al risparmio contrattuale privato. Milan, A. Giuffre, 1957. 8vo, 168 pp., 1,200 lire. (*Saggi di teoria e politica economica. Collana diretta da Francesco Vito,* VI.)
The vital part played in modern economics by the adjustment of investments and savings justifies a careful study of the trends of private contractual saving, which is a main component of global savings.

MARKUS, Vasyl. *L'Incorporation de l'Ukraine subcarpathique à l'Ukraine soviétique. 1944-1945.* Preface by Mr. André Pierre. Louvain, Ukrainian Study Centre in Belgium, 1956. 8vo, 144 pp., bibliography.
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MERING, Otto von,; KING, Stanley H. *Remotivating the mental patient.* New York, Russell Sage Foundation, 1957. 8vo, 216 pp., fig., bibliography, $3.
Despite all the material difficulties involved, the atmosphere of psychiatrical hospitals can be so improved as to facilitate considerably the recovery of mental patients.

MOTWANI, Kewal. *J. Krishnamurti, an introduction.* Madras, Ganesh and Co., 1957. 12mo, xvi + 56 pp., bibliography.
A general account of Krishnamurti's teachings and an analysis of their influence on contemporary thought.

NEUMARK, S. Daniel. *Economic influences on the South African frontier. 1652-1836. . . .* Stanford, Stanford University Press, 1957. 8vo, xvi + 196 pp., fig., $5. (*Food Research Institute, Miscellaneous Publications,* 12.)
A study of white colonial expansion in South Africa; far from being a movement of pioneers desirous of living under a self-sufficing economic system, it was, in fact, determined by the growing demand for the products of the interior.

OCAMPO, Z. Alfredo. *Derecho y ciencias sociales*. Bogotá, Antares, 1957. 8vo, 215 pp., bibliography. (A thesis. [Bogotá Pontificia Universidad Católica Javeriana] 1957.)
This thesis is mainly concerned with the legal sciences. The author analyses, in the first part, the foundations of law, and, in the second part, its objectives. The field of the social sciences proper is discussed only in the third and final part, of 30 pages, entitled 'Introduction to the Social Sciences'.

Organisation (L') des réunions internationales. Manuel publié par le Conseil des Organisations Internationales des Sciences Médicales, créé sous les auspices de l'Unesco et de l'OMS. Paris, Masson et Cie, 1957. 8vo, 113 pp., bibliography.
A practical guide for organizers of international meetings, but also a contribution to the scientific knowledge of the psychological, administrative and other problems raised by such meetings.

PASCUCHI, Marçal. *Politica de salarios*. Cuatro experiencias sobre la relación salarios-costo de la vida. Buenos Aires, Editorial Sudamericana, 1957. 8vo, 317 pp. (*Biblioteca de Orientación económica*.)
Analytical and comparative study of the wage policies pursued in the United States of America, the United Kingdom, France and Argentina since the last world war, with particular emphasis on the frequently illusory character of wage increases which are not based on increased production.

Path of progress for metropolitan St. Louis. Missouri, Metropolitan St. Louis Survey, 1957. 8vo, 121 pp., illustrated, $2.50.
A joint compilation by the two principal universities of the region (St. Louis and Washington), this report gives a picture of the population, economy and administrative organization of 'greater St. Louis', and attempts to predict its evolution during the coming years.

PATTERSON, Gardner; FURNISS, Edgar S., Jr. *NATO, a critical appraisal*. A report prepared by Gardner Patterson and Edgar S. Furniss, Jr. on the basis of an international conference held at Princeton University from 19 to 29 June 1957, Princeton, Princeton University Press, 1957. 8vo, vi + 107 pp. (Princeton University Conference on NATO.)
A general report on a conference, held at Princeton, during which NATO problems were examined in detail.

Prensa (La) de la Iglesia en España. Datos primarios de la Oficina estadística de la Iglesia, elaborados por Angel Orbegozo Urruela. Madrid, Oficina general de Información y Estadistica de la Iglesia en España, 1957. 8vo, 82 pp., bibliography.
Monograph giving statistics of all Catholic newspapers and periodicals in Spain (approximately 100 million copies per year for 30 million Spaniards). Tables, maps, etc.

RICCA-BARBERIS, Mario. *Consuetudine a diritto*. Turin, G. Giappichelli, 1955. 4to, 54 pp., 500 lire.
Series of articles showing, by a number of practical illustrations, that 'everywhere, custom preceded the written law, accompanies it and follows it'.

RICCA-BARBERIS, Mario. *Diritto romano e tradizione nella legislazione civile*. Turin, G. Giappichelli, 1956. 4to, 52 pp., 500 lire.
Series of articles showing the importance of the Roman tradition for the study and framing of civil law in European countries.

SCHWONKE, Martin. *Vom Staatsroman zur Science Fiction*. Eine Untersuchung über Geschichte und Funktion der naturwissenschaftlich-technischen Utopie. Stuttgart, F. Enke, 1957. 8vo, viii + 194 pp., bibliography, DM.16 (*Göttinger Abhandlungen zur Soziologie*. 2. Band.)

With the help of a number of specific examples, the author analyses the causes, extent and significance of the increasingly important place which is being given in contemporary literature to the notion of a scientific and technical Utopia.

SMITH, Bradford; SMITH, Marion Collins. *Why we behave like Americans.* Philadelphia, New York, J. B. Lippincott, 1957. 8vo, 322 pp., bibliography, $4.95.
Study of numerous aspects of American civilization, the central idea being that it is based on the concept of voluntary association.

STAAB, Giles J., O.F.M. Cap. *The dignity of man in modern papal doctrine: Leo XIII to Pius XII. 1878-1955.* A dissertation. Washington, The Catholic University of America Press, 1957. 8vo, viii + 150 pp., bibliography, $1.75 (*The Catholic University of America studies in sacred theology (second series)*, no. 101.)
Analysis of the concept of the natural dignity of man in papal doctrine since Leo XIII. Statement of the practical conclusions to be drawn from it for the solution of the problems of the modern world.

Trade and market in the early empires. Economies in history and theory, edited by Karl Polanyi, Conrad M. Arensberg and Harry W. Pearson. Glencoe, Ill., The Free Press, The Falcon's Wing Press, 1957. 8vo, xx + 382 pp., fig., bibliography, $6.
Economists and historians make a very serious mistake when they assimilate economic systems and market economies: historical analysis shows that trade and currency existed under marketless systems, thus opening the way for a more general concept of economic régimes as institutionalized systems of relations between man and his environment.

UNIVERSITY OF THE PHILIPPINES. *Forty-third annual report of the president* to the Board of Regents for the academic year 1 June 1955 to 31 May 1956. Quezon City, University of the Philippines (no date). 8vo, 200 pp., bibliography.
Administration and activities of the various departments; numerous annexes, particularly lists of works published and research carried out by members of the university.

VERWEY-JONKER, H.; BRACKEL, P. O. M. *The assimilation and integration of pre- and post-war refugees in the Netherlands* . . . with an introduction by M. A. M. Klompé. The Hague, M. Nijhoff, 1957. 8vo, xii + 55 pp. (*Publications of the Research Group for European Migration Problems*, XI.)
A general study based on an analysis of anwers to a very detailed questionnaire; it justifies the conclusion that refugees who have decided to settle in the Netherlands have been assimilated most satisfactorily.

VIVAS, Jorge B. *Sufragio, representación popular y sistema electoral estadounidense.* Buenos Aires, Impr. del Congreso de la Nación, 1957. 4to, 171 pp., bibliography.
Description and analysis of the electoral procedure (including 'primary elections') adopted by the various states of the United States of America.

Who cares? . . . About human relations. . . . A selective and critical bibliography, prepared in committee by the New Jersey Library Association. New York, The Scarecrow Press, 1957. 8vo, 141 pp., $3.
A critical bibliography of 'human relations' (in a very wide sense): individual freedom, relations between children and adults, relations between groups, international relations, etc. Only works published in English are mentioned.

WORTLEY, B. A. ed. *The United Nations. The first ten years.* Manchester, Manchester University Press, 1957. 8vo, viii + 206 pp., 25/- (stg.).
Series of lectures on the role and activities of the various organs of the United Nations during the first ten years of their existence.

Yearbook (The) of world affairs 1957. Vol. II. Edited by George W. Keeton and George Schwarzenberger. London, Stevens and Sons, 1957. 8vo., xii + 480 + iv pp., 42/- (stg.) (London Institute of World Affairs.)

Eleven articles on present-day problems in international relations and the foreign policy of the different States, followed by an important section containing bibliographical notes.

III. NEWS AND ANNOUNCEMENTS

THE ANGLO-POLISH SEMINAR ON THE SOCIAL EFFECTS OF INDUSTRIALISM

London, 10-20 September 1957

S. J. Gould

At the request of the Polish Government and in co-operation with the United Kingdom National Commission for Unesco, Unesco organized in the Autumn of 1957 a seminar on 'The Social Effects of Industrialism'. The seminar was held in London, at the London School of Economics and Political Science (by kind permission of the Director), from 10 to 20 September. The Directors of Studies were Professor Morris Ginsberg, Professor Emeritus of Sociology in the University of London, and Mr. S. J. Gould, Reader in Social Institutions in the University of London. Unesco was represented by Professor T. H. Marshall, C.M.G., Director, Department of Social Sciences, and by Dr. S. Friedman, of the Department of Social Sciences.

The wide scope of the seminar's discussion will be seen from the variety of the topics which various speakers explored.[1] There were ten lectures by British speakers and five from the Polish side.

The programme proved exceptionally crowded, and it is a tribute to the eagerness of the students and the skill of those who lectured to them that interest was maintained at a high level throughout the week. There was also a series of discussion groups in which, with smaller numbers present, it was possible to explore in detail some of the topics arising in the major sessions. These discussion groups, under the chairmanship of Mr. John Smith and Mrs. Christine Cockburn (Lecturers in Social Science at the London School of Economics), explored 'The Political Shape of Industrial Society' and 'Problems of the Social Services'. The participants on the Polish side consisted of five professors (as mentioned above) and twenty-six younger scholars—mainly economists and sociologists, but including also a philosopher and a geographer. On the British side there were some twenty participants drawn from the fields of international history, economic history, sociology (including industrial sociology), theoretical and applied economics, trade union studies and Soviet studies. All the discussions were held in English and tributes were frequently paid to the mastery of the English language shown by the Polish participants. Professor Ginsberg took the chair at nearly all the main sessions of the seminar, and the seminar was greatly in his debt for the skill and calm with which he performed this exacting role.

A meeting of this kind may be held to serve two distinct but related purposes. On the one hand it provides for an interchange of scientific information and ideas upon a theme of international interest. This opportunity was certainly taken up. The second purpose of such a gathering is to enable the visitors to make scientific contacts which will be useful to them in carrying out their work as scholars either in teaching or in research. This too was an aim which the seminar helped to further. Opportunities were provided, outside the formal activities of the seminar for the Polish scholars to get in touch with

1. H. L. Beales, The historical background of British industry; Professor G. D. H. Cole, Changes in the occupational structure of Great Britain during the last 100 years; D. G. MacRae, The working class in industrial society; Professor E. Devons, The balance of production; Professor J. Drewnowski, Problems of the development of Polish industry; Professor W. Brus, Industrialization and standard of living in Poland; Professor W. Stys and Dr. W. Klatt, Peasants in industrial society; Dr. M. Wise, Urbanism and industrialism; Professor R. Titmuss, Health as an element in welfare; Dr. V. D. Lipman, Housing and industry; Professor J. Gorynski, Report on housing policy; Professor A. V. Judges, Education and industrialization; Sir Sydney Caine, Industrialism in South-East Asia; Professor E. Lipinski, The economic incentives in a socialist-planned economy.

their opposite numbers in various specialized fields of study. Our thanks are due to the Royal Institute of International Affairs, to the British Institute of Public Opinion, the Ministry of Housing and Local Government, the Institute of Personnel Management and the National Institute of Industrial Psychology, to name only some of the agencies to which it was possible to introduce the Polish visitors. The latter were thus able to obtain answers to specific queries, fill gaps in their documentary research and so on. This was not the least successful of the activities in the ten very crowded days of the seminar programme. There were several social occasions—receptions to mark the opening and closing of proceedings; a reception given by the Director of Unesco's Department of Social Sciences, at which many distinguished British visitors were present; a reception at the Ministry of Education at which the participants, both British and Polish, were received by Sir Edward Boyle, the Parliamentary Secretary to the Ministry of Education; and a cocktail party arranged by the Polish Embassy. On Saturday, 14 September, the British Council kindly organized a tour of Eton College, Windsor Castle and Slough Trading Estate for the Polish scholars.

I do not propose to summarize all the lectures given at the seminar. That would take far more space than is at my disposal. What I intend to do is to cite some of the central themes which dominated the seminar's discussions. These themes were discussed for the most part in the light of experience in Britain and Poland. But the problems arising from such experience are not confined to those countries. As more than one speaker emphasized, if we learn from the mistakes and successes of the more 'advanced' societies (i.e., the societies which have gone farthest along the road towards industrialism), we can all avoid some very serious errors. There was much emphasis on the 'aims' of industrialization. The most widely accepted aim (or should I say 'function'?) was that of raising the standard of living of the mass of the population; of banishing the age-old perils of poverty and disease; of destroying the barriers which illiteracy places in the path of moral and cultural progress. In the twentieth century, aims of this kind are very widely recognized and those who argue against them in the modern world find very little support.

As was clear from Mr. Beales' lecture, in the origins of British industrialism there was much less 'conscious' acceptance of these aims than is the case with countries facing industrialization in the twentieth century. Industrialization now is not simply the result of 'growing populousness' or of spontaneous endogenous shifts in technology. It is linked with wise aspirations, aspirations which are the roots of modern democratic ideology in all its forms. It is thus that several problems of the highest importance arise.

1. Firstly, at what pace should countries pursue industrialization as a means of attaining the 'good life'?
2. At what short-term costs, both for those who are engaging in the newer manufacturing industries and for those in the more 'traditional' rural communities, should it be pursued?
3. What social ideals does this process help to generate? How do these ideals square with ancient, permanent and pre-industrial ideals, e.g., those of equality and liberty?

The problems of pace are clearly very important in the Polish and in the general East European context. These were not evaded by the Polish economists who addressed the seminar. Professor Drewnowski, for example, though he defended the policy followed in Poland of 'heavy industrialization first', recognized the difficulties connected with such a policy, namely: the low productivity of investments during the initial period; problems arising from different levels of technical attainment within the same economy; problems, more sociological than economic in character, which arise when a peasant labour force migrates and is transformed into unskilled industrial labour; lack of balance resulting from overworking of plant and equipment and from shortage of working capital. These difficulties Professor Drewnowski classified as 'unavoidable', but in addition to these unavoidable difficulties he very frankly mentioned difficulties that were in principle avoidable but which had, in recent Polish history, proved a source of serious concern. These included over-centralization, neglect of local autonomy and neglect of a 'rational' system of prices. Professor Drewnowski believed that a large measure of central planning was not incompatible with greater reliance on market mechanism

and decentralization of enterprise. Though he did not enter into political detail, there is now ample evidence to prove how, in authoritarian societies, irrelevant items of ideology can impede the process of industrial growth. So much so that Professor Brus in his discussion of post-war Polish events was able to quote estimates of a fall in real wages such that 'the period from the middle of 1951 to the middle of 1953 showed lower real wages than the initial level of 1949'. Professor Brus listed a series of respects in which a centrally planned economy offered advantages, ethical, economic and psychological. But he admitted readily that these advantages were 'only potentially present', and explained how in recent Polish experience they had been offset by 'negative factors', e.g., an excessive rate of investment in the years from 1950 to 1953; excessive attention to the claims of heavy industry (including military preparations) as distinct from light industry, neglect of the supply of consumer goods, mistakes in agricultural policy and in the over-centralization of industry. These had all proved embarrassments and it was now hoped that after the events of October 1956 the more relaxed pace would produce more socially satisfying results. Professor Brus also made interesting reference to some of the socio-psychological problems that arise when aspirations are sharply raised. Within a society undergoing industrialization even a small rise in real income brings forth new standards of comparison and new discontents. It was interesting to see a very similar point stressed by Sir Sydney Caine in his comments on a very different social and political setting in South-East Asia.

None of the Polish speakers would go so far as to accept the very sceptical analysis of economic growth which Professor Devons presented to the seminar. Yet they showed themselves keenly aware of the risk that too rapid a pace would lead not to growth but to stagnation. It is quite clear that many of the countries embarking upon ambitious programmes of industrialization do so with inadequate managerial and technical experience, and that the planning and execution of large-scale programmes (even when unaccompanied by excess of political zeal) are much more complicated than is often supposed. This is not to say that programmes of industrialization should be jettisoned, but rather that the manner of their execution should be carefully planned and constantly scrutinized.

The essence of industrialization consists in making the present generation endure some measure of sacrifice so that future generations will benefit. It is not always easy to do this once aspirations for a better life have been aroused and given institutional expression. As Professor Stys showed in his talk on peasantry, the agrarian sector is of crucial importance in the building of any kind of industrial economy, socialist or otherwise. And governments sponsoring industrialization are often distracted by the pressing needs of the urban population. What these mean in terms of housing policy and development was implicit in all that Professor Gorynski, Dr. Wise and Dr. Lipman had to say. Yet the other side of the coin is the fate of the peasant. It was here that both Dr. Klatt and Professor Stys in their respective papers touched upon fundamental and controversial issues. Dr. Klatt felt that East European governments, in recent years, had taken the 'size of the agricultural unit' as the criterion of economic efficiency instead of the more logical alternative, i.e., 'capital and labour input'. He showed how this error was deeply embedded in Marxist dogma. Professor Stys, who guided the seminar with great charm through the intricacies of Polish rural history, showed how collectivism had led to rural disinvestment on a serious scale, and had threatened the stability of the industrialization plan. If the rural basis for economic development is chaotic, little lasting progress can be achieved. There had been recent changes upon which Professor Stys had much of interest to say. The dissolution of more than 90 per cent of collective farms 'indicates what was the true attitude of the peasants towards collectivization. The remaining collective farms in Poland are carefully studied in order to find out what were the motives of these peasants who preferred to remain in the collective'.

I have not yet referred to a group of lectures given by British speakers which dealt with aspects of social structure and with the welfare state. Professor Cole gave a detailed analysis of the occupational structure of Britain for the last 100 years, based for the most part on census material. Mr. MacRae dealt specifically with the political organization and ideas of the British working class. Professor Titmuss and Professor Judges were

concerned, like Mr. MacRae, as much with ideals as with socio-economic history. They indicated how ideals in the fields of health and education are interwoven with the process of economic growth and with technological change. In an advanced industrial society, for example, the whole meaning of 'health' is transformed and the possibilities of general welfare, for the first time in human history, become visible. Whether they become actual depends to a great extent upon the skill and insight which societies are willing to put into planning and administration. What this means in practical terms in the British context was something in which the Polish participants were clearly and consistently interested. This came out with especial force in the discussion groups when experiences were exchanged on the key topics of trade union freedom, local autonomy, and the execution of social welfare policies. The British participants were also interested to hear from Professor Lipinski and others of the hopes placed by many people from different levels of society in contemporary Poland in schemes of profit-sharing and workers' control.

Many of those who participated in the seminar felt that the technical problems, e.g., in planning a health or housing policy, will, *mutatis mutandis*, show remarkable similarities in all industrial societies. But human needs, although thwarted by planning that is technically 'bad' are not fully satisfied by planning that is technically 'good'. Social research and interchange of information can help to show us both how little and how much we know on these questions of technique. But both British and Polish speakers were well aware that unless these techniques are fully geared to what Mr. MacRae called 'the original purpose of the French Revolution, the slogan of 'Liberty, Equality and Fraternity', the result would be at the very least social waste, if not, at the extremes, moral squalor. It was not simply ethnocentricism which led many of the British speakers to claim that from the British 'welfare society' many useful conclusions could be drawn. It is a form of society in which collective effort helps to control the hazards inseparable from industrial growth. And although there is no 'final solution' in this field, it is a way of solving some problems both of liberty and equality in their modern form. It was encouraging to see that so much interest during the seminar should centre on the analysis of welfare and its components, and on the political framework in which welfare is sought. For the claims of genuine liberty and equality in an industrial setting have of late been sadly confused by fanatics and partisans. There are hopeful signs that the tide is turning in favour of a more rational approach to the question. One such sign was the presence of this group of Polish scholars in London and the fruitful and scholarly discussions which their presence helped to make possible.

THE ROUND TABLE OF THE INTERNATIONAL INSTITUTE OF ADMINISTRATIVE SCIENCES

Opatija (Yugoslavia), 20-25 June 1957

The International Institute of Administrative Sciences held its annual Round Table at Opatija in Yugoslavia, from 20 to 25 June 1957; more than 160 persons, representing 33 countries and international organizations, took part in it.

The formal opening meeting was held on 20 June, under the chairmanship of H.E. Mr. Frants Hvass, President of the International Institute of Administrative Sciences.

Mr. Nikola Stjepanowić, Chairman of the Yugoslav national section of the International Institute of Administrative Sciences, and Mr. V. Ljumovic, Under-Secretary of State and General Administrative Secretary of the Federal Executive Council of the Federal People's Republic of Yugoslavia, welcomed the members. The chairman then thanked the Yugoslav authorities and the organizers of the

Round Table, and opened the discussion. The Director-General of the Institute, Mr. P. A. Schillings, briefly described the background and activities of the Institute and mentioned the names of those who had organized it and were co-operating in its work. He emphasized the importance of the Round Tables held since 1948, in the intervals between Congresses, as a means of ensuring continuity in the Institute's activities and establishing closer contacts between its members.

There were three subjects on the agenda for discussion at the plenary meetings:

1. Present trends with regard to the transfer of powers from higher authorities to independent lower bodies and vice versa. (Rapporteur: Mr. Brian Chapman (United Kingdom), Professor at Manchester University.)
2. Automation and the problems it raises in the field of public administration. (Discussion leader: Mr. Lyonel Wurmser (France).)
3. Methods used for promoting civil servants on merit, with particular reference to the system of performance reports. (Rapporteur: Mr. N. Nikola Stjepanović (Yugoslavia), Professor at the University of Belgrade.)

On the first and the third item, all the Institute's national sections had been asked to draw up reports; several of these reports had been reproduced by the national sections concerned and were distributed to the members. In addition to the general report devoted to each of these subjects, members also received a summary of the main points in the various national reports.

It had been decided that the second item should be dealt with in a series of formal addresses, as a sufficiently advanced stage of development had not yet been reached to afford matter for an exchange of views. The programme was planned to provide basic information on two aspects of this problem, by means of (a) a general consideration of the technical factors involved and of recent achievements in the field of automation, and (b) an outline of the psychological, legal, economic and social implications of automation in the public services. Although, for the reasons already stated, no reports had been requested from the national sections, a brief working paper had been prepared as a guide for the discussion of this subject, and distributed to the members.

Present Trends with regard to the Transfer of Powers from Higher Authorities to Independent Lower Bodies and vice versa

The first item on the agenda took up three working meetings. The rapporteur, Mr. Brian Chapman, first drew attention to the terminological confusion in the national reports. He therefore suggested some preliminary definitions to clarify ideas and ensure equivalence between the corresponding French and English systems:

Decentralization of powers (décentralisation territoriale): transfer of powers to elected local authorities, normally chosen on a territorial basis.

Deconcentration of powers (déconcentration): transfer of powers to subordinate administrative authorities, either administrative units or persons (prefects, governors, etc.).

Devolution of powers (dévolution de pouvoirs): decentralization by services, i.e., the transfer of powers to special bodies, with independent legal status, other than the State, central ministries or local bodies. This term covers a great variety of institutions (with several subdivisions) ranging from the *établissement public* and the *öffentliche Anstalt* to the public corporations established by law in 'common law countries'.

Having thus dealt with the linguistic difficulties, the rapporteur proposed that the main trends now apparent with regard to the transfer of powers should be regrouped. He distinguished, first, common law countries, where the continuing increase in the number of economic and social institutions constituted a form of decentralization; secondly, administrative law countries, particularly France, where developments were outstripping the law and the number of institutions of widely varying status was growing, thus constituting a disguised form of decentralization: and, lastly, socialist countries, where the problems of decentralization had special features of their own. In fact, as Mr. Jaroszynski (Poland) was to emphasize during the discussion which followed, the centralization imposed by the circumstances prevailing during the post-revolutionary period

must later give way to a system of decentralization—first political and then administrative—designed to ensure the exercise of power by the people.

Outstanding features of the discussion on Mr. Chapman's extremely interesting report were the speeches made by Mr. Henri Puget (France) on the historical development of the balance between centralization and decentralization; by Mr. A. de Laubadère (France), on the transfer of powers of decision, rather than executive powers, to bodies such as those controlling the liberal professions; and by Mr. Gerrit Abraham van Poelje (Netherlands), on the position of corporate bodies vis-à-vis the modern State; and a large number of additional reports on decentralization in the various States represented at the Round Table. These addresses, the object of which was to elaborate the information contained in the national reports, enabled the Rapporteur to draw the following conclusions from the discussions:

1. In the older countries, with a tradition of local government, there is a constant fluctuation between the centralizing and decentralizing tendencies, whereas, in recently established or recently unified countries, the central government at the outset enjoys extensive power, which should evolve in the future.
2. Technically, the devolution of powers has usually been effected in an anarchical and chaotic fashion, both in law and in fact. It has become very difficult to determine the existing trends.

One fundamental problem raised, particularly by Mr. Puget, was that of maintaining a proper balance between the centralizing and decentralizing tendencies. This problem arises in all countries, irrespective of their political, economic or social structure. Efforts must be made to establish such a balance between the State and Society by finding the happy mean. It was remarkable, incidentally, that none of the countries represented endeavoured to maintain that centralization was a good thing in itself (whereas this system had formerly had numerous supporters), and it should be noted that this was an implicit moral condemnation of centralization.

Automation and the Problems it raises in the Field of Public Administration

In the preparation for the seminar on the problems of automation, two American experts, engaged by the European Productivity Agency to carry out several missions covering most of the countries of Europe, had been placed at the Institute's disposal: Professor O. Richard Wessels, President of the Department of Business Education and Office Management of Syracuse University (United States of America) and Mr. Edward J. Gauthier, Vice-President in charge of Office Management, Hardware Mutuals. They were assisted by Mr. Lyonel Wurmser and Mr. Lucien Mehl (France).

Professor Wessels first spoke on the topic 'What is automation?', giving instances drawn from both factory and office work, and pointing out, in particular, the distinction between mechanization and automation. Various lantern slides were shown, as well as a film, 'What is automation?', indicating the various possibilities of applying automation to the process of manufacturing numerous products.

Mr. Lyonel Wurmser chose as the subject of his address the administrative aspects of automation in government departments, while Mr. Lucien Mehl (France), speaking on the legal aspects of automation in public administration, pointed out that the relations in public administration, pointed out that the relations between automation and law could be considered from two different angles—from the standpoint of the automation of law and from that of the use of automation in relation to legal information and even legal reasoning. Mention may also be made of the problems of the law on automation and its applications, mainly in the field of public administration.

Mr. Gauthier (United States of America), referring to the questions which should be settled as a preliminary to automation, dealt in particular with the question whether, in a given situation, automation was opportune and feasible, and, if so, what was the best method for the gradual implementation of the programme laid down.

After Mr. Wurmser had given a general account of the effects of automation on public administration, Messrs. Martin Müller (Federal Republic of Germany), Roberto

Coletta (Italy) and J. E. Dunkley (United Kingdom) described the experience gained or results achieved in the matter in their respective countries.

Methods for promoting Civil Servants on Merit, with Particular Reference to the system of Performance Reports

Mr. N. Stjepanović (Yugoslavia) emphasized in his report the need for basing the promotion of civil servants—either by salary increments or by promotion to a higher grade—on merit alone. The system of performance reports i.e., 'the systematic appreciation, in accordance with a pre-established scale, of the merits of a civil servant, considered from different standpoints during a given period of time', represented the most widely used method of applying that principle. The rapporteur therefore proposed that the following four aspects of the problems should be considered: (a) The aims and role of performance reports as an instrument for improving administrative efficiency; (b) The means of applying the system of performance reports, i.e., not only the factors to be included and the criteria to be observed, but also questions of competence and procedure; (c) The effects of performance reports in the actual promotion of civil servants; (d) The legal guarantees with respect to performance reports and the civil servant's right of appeal.

In a series of addresses on these various aspects of the problem, many speakers gave an account of their countries' experience in the matter and drew theoretical conclusions therefrom. At the close of the discussions, the rapporteur summed up the main points dealt with, as indicated in the following paragraphs.

Regarding the role of performance reports, it was generally recognized that they constituted a means of providing a criterion for promotion which could be used as a corrective to the rule of seniority and could also be applied to other matters relating to the career of civil servants.

Methods, competence and procedure are the most difficult questions and might well be the subject of a separate round-table discussion. The main speeches, particularly those by Messrs. Henry Puget and Guy Braibant, Sir A. J. T. Day and Mr. André de Labaudère, were devoted to these questions.

It was not found possible to draw any final conclusions regarding the extent of the effects produced by performance reports. Messrs. Alain Plantey and Bosko Perić and Mrs. Beatriz Marques de Sousa Wahrlich emphasized, in particular, the limitations of the system as compared with the parallel criterion of seniority—the importance of which had been noted by Messrs. Joshua Harmon and Manuel Alonso Olea—and in the case of promotion from grade to grade as opposed to promotion within any particular grade.

The factors taken into consideration when a performance report is being drawn up deserve particularly close attention, for the question then arises whether the report should concern the man or simply the civil servant. The French speakers maintained the view that facts concerning the civil servant's private life should not be taken into account, except in very special circumstances. On the other hand, Mr. William F. Larsen defended the view commonly held in the United States of America, that there was a definite correlation between the individual's private behaviour and his public conduct, and that it would therefore be dangerous to perpetuate a distinction considered to be artificial, and to leave unpunished activities, or even opinions, running counter to the security of the State. Mrs. T. A. Yampolskaya pointed out that, in the Union of Soviet Socialist Republics, it was the practice to form a judgement on the merits of the individual as a whole and not simply on the strictly professional side of the civil servant's life.

The need to provide for legal guarantees to accompany the system of performance reports was generally recognized, but it was not possible to draw any precise conclusions with regard to the kinds of safeguards to be recommended.

THE FIRST MEETING OF THE SUB-COMMITTEE ON INDUSTRIAL SOCIOLOGY

Paris, 27-29 June 1957

The Research Sub-committee on Industrial Sociology established by the International Sociological Association met at Unesco House in Paris from 27 to 29 June 1957. The meeting, which adopted as its main theme for discussion the different forms and degrees of workers' participation in management, was chaired by Professor Jan Szczepanski (University of Lodz, Poland). Professor Georges Friedmann (France), President of the International Sociological Association, opened the meeting, which was attended by the following members of the sub-committee: Dr. Ralf Dahrendorf, University of the Saar, Federal Republic of Germany; Professor P. Kuin, University of Amsterdam, Netherlands; Dr. Albert Meister, Centro di Sociologia della Cooperazione, Italy; Professor Camillo Pellizzi, University of Florence, Italy; Professor Knut Pipping, School of Social Sciences, Helsinki, Finland; Dr. W. H. Scott, University of Liverpool, United Kingdom; Dr. I. Stanojćić, University of Belgrade, Yugoslavia; Professor Gunnar Westerlund, University of Stockholm, Sweden. Also present were: Professor Louis Kriesberg, University of Chicago, United States of America, Mr. Alain Touraine, Centre d'Études Sociologiques, Paris, France; Mr. T. B. Bottomore, Executive Secretary, International Sociological Association; Miss Merran McCulloch, Assistant Secretary, International Sociological Association. Professor René Clémens (Liège), Professor Carl Jantke (Hamburg), Mr. J.-D. Reynaud (Paris) and Professor Harold Sheppard (Detroit) were unable to attend.

Nine working papers were presented for discussion and will shortly be published in one volume by the International Sociological Association. The discussions were lively and were centred largely around the problem of the ownership of industry. Some contributors believed the only basis for an effective participation of workers in management lay in public ownership of industry. For them, the problem was expressed in terms of workers' control of industry in a socialist society. Others took the opposite view and considered that workers' participation in management was a characteristic of a free enterprise economy and was simply an extension of trade union activity.

Although the relationship between ownership, control and participation in management still remains to be clearly defined, the discussion did shed some light on actual experience in this respect in different societies. It became apparent that in every form of industrial organization there is some conflict between management and labour which has to be recognized and provided for in the institutional structure, The discussion also raised the problem of the role of trade unions and of the relationship between trade union representatives and workers' representatives in management. The conference recommended a broad framework for new research, which the members of the sub-committee will try to promote in their own countries. The major themes of research which were considered desirable included:

1. The structural context of workers' participation in management, i.e., the relations between the enterprise and the society in which it operates.
2. The ideological context of participation, especially social doctrines concerning capitalism and socialism, and the problem of property relations.
3. The more specific values and attitudes connected with the introduction or extension of participation, including expectations and perception of the situation by workers and managers.
4. Attitudes resulting from participation, e.g., how far have expectations been fulfilled?
5. The institutional structure of participation, e.g., the structure of trade unions, works councils, etc., and the structural relationships between organs of conflict and organs of participation.
6. Changes in the formal structure of the enterprise resulting from participation, e.g. changes in management structure, decision making, supervision, etc.

7. Changes in the working class resulting from participation, e.g., changes in way of life, attitudes, possibilities of social mobility, etc.

AN INTERNATIONAL COURSE ON WORLD CULTURES AND CIVILIZATIONS

Baugé, 14-24 July 1957

An International Study Course on World Cultures and Civilizations was organized by the French Esperanto Co-operative on behalf of the Universal Esperanto Association in furtherance of the consultative relationship between Unesco and the Association. The ten-day course (14-24 July 1957) was held in the Co-operative's headquarters, formerly the Château Grésillon, Baugé. Sixty persons from thirteen different countries took part and were joined for several of the talks and debates by some twenty visitors from the nearby town of Angers.

The course was designed to give a general survey of the subject and in particular of the work of Unesco in improving understanding between the various cultures and civilizations.

Three lectures were given on each of the sub-titles. W. Auld, of Glasgow, gave a concise and critical analysis of Toynbee's theories, under the title 'Toynbee and the Life of Civilizations'. Dr. A. Albault, of Toulouse, dealing with the biological aspect, devoted his lectures to population problems and their relation to the cultural life of peoples, with particular reference to the problems of alcoholism and malnutrition. In contrast, Mr. R. Watier, of Paris, spoke of the technical factor in the formation of cultures and civilizations. He outlined the main steps in technical development under the general title of 'From the Seventeenth Century to "Automized" Civilization'. These talks were illustrated by films on automation (Renault, La Télémécanique Electrique, etc.).

Profiting from the location of the course, Professor G. Waringhien (Paris), gave a detailed analysis of the civilization of the Loire Valley. In his first talk he spoke of its geophysical character; in the second, the history of a typical town, namely, Tours; in the third, the artistic aspect. During excursions, one by day, the other by night, to the most celebrated châteaux of the Loire, his comments contributed greatly to an understanding of the character and history of the region.

Finally, Professor I. Lapenna (London) explained the aims and work of Unesco, stressing the following aspects: its activities in bringing about a *rapprochement* between the various cultures, in organizing conferences and lecture courses and recording the history of culture and civilization; its efforts to solve racial problems and to overcome inter-racial prejudices; its sponsoring of the translation of important works and the reproduction of works of art; its endeavours to protect cultural values, etc. Unesco posters and diagrams in Esperanto were on view during the course and mention was made of the efforts which Unesco is making in these fields.

The lectures fitted into a unified pattern and the questions and answers which followed each lecture contributed to this unity. The final day was given over to a review of the course and to general discussion.

The course was a complete success, this being largely attributable to the ideal setting in which it was held. The Esperanto Cultural Centre at Château Grésillon stands in beautiful surroundings, with a large natural park. It has been especially adapted for occasions of this nature, and has special lecture rooms, equipped with film-projectors, tape-recorders and similar facilities. All those attending lived in the château for the ten days of the course and were able to discuss the lectures, not only during the organized periods but also in informal conversation at mealtimes and during walks and outings.

At the final meeting on 24 July, a resolution was passed expressing appreciation of the results already attained by Unesco in bringing about better understanding among the various peoples and pledging the full support of those present to Mr. Luther H. Evans, Director-General of Unesco, and his colleagues for the work now in hand.

The only language employed throughout was, of course, the international language Esperanto.

THE INTERNATIONAL CONGRESS FOR THE STUDY OF SAVINGS PROBLEMS

Paris, 30 September-3 October 1957

The existence of vast investment programmes in the majority of countries is a characteristic feature of the modern world. It is generally recognized that the success of these programmes depends to a very large extent on the development and judicious use of voluntary savings.

The economic and statistical aspects of the problem therefore deserve closer investigation and the comparative merits of the solutions arrived at should be carefully studied, since the question of how to bring voluntary savings up to the level of desirable investments and consequently to determine the most appropriate means of achieving that objective is a major economic problem in every country. However, in deciding on the best means to adopt, the first step should be to acquire a certain amount of information on the behaviour of the saver—not on the behaviour of voluntary savers in general, but on that of each particular class of saver. Thus, looking beyond the over-all figures as produced, for example, by national accounting services, we must consider the question from the point of view of the individual in his environment. A study of this field, hitherto little explored from the 'quantitative' angle, should yield a great deal of useful information; in particular, it should be possible to discover how any given form of encouragement to small savers affects the general results. Step by step, such information would make it possible to work out an entire economic policy.

In view of this need for information, it was decided to convene an International Congress in Paris. At this congress, the discussions were focused on the two following topics:

1. Has there, since the beginning of the century, been any change in the behaviour of individuals in regard to the accumulation and placing of savings? What have been the main factors in this evolution, and what changes have they brought about?
2. What means have been employed in trying to influence individuals to save more and to ensure that such savings are used so as to be more profitable both to the individual concerned and to the community as a whole? What results have been achieved?

These topics, though phrased in very general terms, nevertheless clearly corresponded to quite specific objectives in the minds of the congress organizers. They were intended to make it possible to collect international documentation on different experiments in the matter of savings conducted in the various countries, and on the reactions of those concerned.

The idea of holding this congress originated with the Mouvement National d'Épargne (France), which would have preferred the whole project to be sponsored by an international committee, thus associating a number of countries with the planning and implementation of the project from the outset. However, in the absence of any international organization responsible for studying the general problem of the accumulation and use of savings, it seemed that the establishment of such a committee might have appeared arbitrary or led to regrettable omissions.

For this reason the congress was placed under the auspices of an almost entirely French Honorary Committee and Organizing Committee.

The committee members were leading figures, in both government and private circles, interested in the subject of savings.

The congress was presided over by Mr. Edouard Escarra, Honorary President of the Crédit Lyonnais, and the Secretary of the Congress was Mr. Paul Fabre, Secretary-General of the Mouvement National d'Épargne.

Eighteen countries took part in the preparation of reports on the two topics on the agenda. The following is a list of these countries and of the rapporteurs who represented them:

Austria: Dr. W. Hirschmann, Secretary-General of the Austrian Bankers' Association (topic No. 2).

Australia: A representative of the Bank of New South Wales (topic No. 2).

Belgium: Mr. Jean Van Houtte, former Prime Minister; Professor at the Universities of Ghent and Liège (topics Nos. 1 and 2).

Canada: A representative of the Royal Bank of Canada (topics Nos. 1 and 2).

Denmark: A representative of the Danish Bankers' Association (topics Nos. 1 and 2).

Finland: Mrs. Armas Makkonen, Honorary General Director of the Helsingfors Aktiébank (topics Nos. 1 and 2).

France: A representative of the Mouvement National d'Épargne (topic No. 1). Mr. Flamant, Professor of Political Economy at the Faculty of Law, Poitiers (topic No. 2).

Federal Republic of Germany: Dr. Heinrich Strathus, Member of the Administrative Committee of the Bundesverband des privaten Bankgewerbes (topic No. 1). Mr. Horst Baumann, Member of the Governing Board of the Deutscher Genossenschaftsverband (Schulze-Delitzsch) (topic No. 2).

Greece: Mr. Jean Koulis, Professor at Athens University (topics Nos. 1 and 2).

Israel: Mr. Shattner, National Commissioner, Department of Savings, Ministry of Finance (topic No. 2).

Italy: Mr. Amedeo Gambino, Professor of Political Economy, Rome University (topic No. 1). Mr. Giuseppe Alpino, Deputy, Vice-Chairman of the Institute of Parliamentary Studies (topic No. 2).

Mexico: Dr. Paul Garranca Y Trujillo, Professor at the Faculty of Law, Mexico City; Delegate of the Patronato del Ahorro Nacional (topics Nos. 1 and 2).

Norway: Mr. Kaare Petersen, Director of the Economic Research Institute of Norwegian Commercial Banks (topics Nos. 1 and 2).

Spain: Mr. Antonio Rodriguez Robles, Inspector of Finance; Professor at the Faculty of Economics, Madrid (topic No. 1). Mr. Juan Marti Basterrechea, Inspector of Finance, Professor at the Faculty of Economics, Madrid (topic No. 2).

Sweden: Mr. Lars Tiger, Director of the Statistical Services of the Association of Swedish Banks (topic No. 1). Dr. Bengt Metelius, Economic Adviser to the *Svenska Handelbanken* (topic No. 2).

Switzerland: Mr. Emile Duperrex, Assistant Director of the Banque populaire Suisse (topic No. 1). Mr. Francis Yaux, Director of the Banque Cantonale Vaudoise (topic No. 2).

Turkey: Mr. Fadil H. Sur, Professor of Political Economy and Public Finance at the Faculties of Law and Political Science, Ankara (topics Nos. 1 and 2).

United Kingdom: Mr. W. F. Crick, Director-General of the Economic Studies Service of the Midland Bank (topic No. 1). Mr. Alan T. Peacock, Professor of Political Economy at Edinburgh University (topic No. 2).

A collection of the national reports, in two volumes, was published prior to the congress.

Seven other countries, which had not taken part in the preparatory work, sent delegations to the Congress. These countries were: Haiti, Ireland, Japan, Lebanon, Luxembourg, Netherlands, Uruguay. In all, therefore, twenty-five countries, represented by a total of some two hundred and fifty delegates, took part in this Congress.

In addition to the national reports, a general report on each of the two topics was drawn up, making a synthesis of the different papers received and drawing the necessary

comparisons. The general reports were prepared by Mr. J.-M. Jeanneney (Professor of Political Economy at the Faculty of Law, Paris) on the first topic, and Mr. R. de Baerdemaker (Secretary-General of the Belgian National Committee for the Promotion of Personal Savings) on the second topic.

The text of these reports is included in Volume III of the proceedings of the congress; this volume also contains a verbatim record of the debates, a list of those who attended the congress, and the texts of the resolutions adopted.[1]

A great many interesting ideas and original points of view emerged from the debates, which lasted for nearly four days. The debates were not, however, sufficient to exhaust the substance of the questions raised; on the contrary, they repeatedly revealed gaps in statistical knowledge and the difficulties inherent in that subject.

In its resolutions, the congress accordingly laid great emphasis on the necessity for very thorough studies to be conducted in each country before any further progress could be made on the lines planned.

The congress also arrived at a number of decisions concerning certain economic policy measures. In this respect, the following resolutions are to be noted:

'The congress affirms that stability of currency values is a basic condition for the accumulation of savings and their sound use, as it is for any financial calculation of long-term validity. It also recalls that, in the present circumstances, the development of individual savings is one of the essential conditions for monetary stability, as well as for economic growth and the rapid improvement of standards of living.

'It emphasizes the fact that, while the practice of guaranteeing the value of loans in terms of the cost of living index may facilitate subscription and protect certain savings, it is to be recommended only in so far as it encourages the public authorities to make an effective stand against any rise in the general level of prices. It recommends that the problem be carefully studied. The congress expresses the hope that fiscal policy, which already aims at full employment and social justice, will also endeavour to give systematic encouragement to all forms of saving leading to productive investments.'

The congress also hoped that a vigorous effort would be made to educate the public with respect to savings.

In assessing the task which lies before it, simply in terms of the accomplishment of its initial objectives, the congress concluded its work by recommending the creation of an international body for research and documentation, which would establish permanent relations with the institutions concerned. A commission is to study this question with particular care and submit its proposals to the next congress.

AN INTERNATIONAL CONGRESS ON 'INDUSTRIAL TRAINING'

Rapallo, 3-8 February 1958

In February 1958, the IAI (Istituto per l'Addestramento nell'Industria (Institute for Industrial Training), in co-operation with the International Labour Office convened an international congress on 'Industrial Training'. This congress was attended by industrial leaders, experts on psychology, sociology and organization, teachers from vocational training institutes, trade unionists and members of organizations and enterprises concerned with industrial training.

1. The proceedings of the International Congress for the Study of Savings Problems are published and distributed by the Mouvement national d'épargne, 149 rue de Grenelle, Paris 7e. The price of the three volumes is 2,500 francs in France and the French Union, 3,000 francs for other countries.

The congress was held at Rapallo, on the Italian coast, from 3 to 8 February 1958. Other promoting bodies, in addition to the IAI which took part were: IPSOA, CNP and ISDA (Italy); (FIMTM, UIMM and OICOS (France); COFCE (Belgium); CEAM (Spain); and ASB (Germany). The congress was held under the auspices of the European Productivity Agency and the International Organization of Employers.

The work programme, already drawn up by the IAI and approved by the other promoters, provided for study of the following subjects: the evolution of needs in the matter of vocational training; the organization and direction of industrial training; the rational evaluation and organization of training activities either in the enterprise itself or in public institutions and bodies concerned with such activities. These subjects were discussed by the various commissions, and the conclusions will be set out and co-ordinated in a final report.

(IAI), Via Parini 3, Milan, Italy.

CARNEGIE ENDOWMENT FOR INTERNATIONAL PEACE—EUROPEAN CENTRE

172 Route de Ferney, Grand-Saconnex, Geneva, Switzerland

The Carnegie Endowment for International Peace, in order to encourage research by Europeans into problems of international organization, to help young scholars to have interesting works in this field published, and to make generally available studies which might not otherwise see the light of day, announces an international competition, which will take place annually until 1959.

REGULATIONS

Subject. Contributions may deal, on the basis of a serious analysis of experience, with any aspect of the activity of international organizations. They must consist neither of abstract speculations regarding the nature and utility of international organizations, nor of mere descriptions of the functioning of institutions. For the purpose of this competition, the term 'international organization' will be understood to mean general or regional intergovernmental agencies.

Closing date. Entries must be received not later than 1 July 1958 in order to be eligible for the prizes offered in 1958.

Eligibility. Inasmuch as the purpose of the prizes is to encourage research by persons who have not yet had an opportunity to establish a reputation, the competition is open only to persons who have published at most one book in the field of history, law or the social sciences. In determining eligibility, a doctoral dissertation reproduced in a limited number of copies will not be counted as a published book.

In order to equalize the conditions of competition, two parallel series of awards will be established, the first for manuscripts and the second for printed books. Dissertations will be accepted as entries if they fulfil the conditions of contest.

Contestants in either category must also satisfy the following additional conditions: (a) Nationality: Competitors must be nationals of the United Kingdom, Eire, or one of the countries of Continental Europe, or have resided in one or more of those countries for at least ten years, as of 1 July 1958. (b) Age: Contestants must not have passed their fortieth birthday on 1 July 1958.

Language. Entries may be written in English, French, Italian or German.

Form of submission. Entries in the manuscript section of the contest must be typewritten, double-spaced, on one side of the page only. Carbon copies are acceptable provided they are clearly legible. Published works shall be submitted in the form of the printed volume. In either case, five copies are required.

Length. Studies should be of the order of 90,000 words or 300 printed pages. Primary emphasis in judging will be placed on content rather than on length.

Judging. Entries will be judged by a committee of five specialists in the field of international relations, including three Europeans, one North American and one member from another continent.

Form of the awards. (a) The Carnegie prize in the manuscript section of the contest will comprise a cash award of $500 and publication of the winning entry at the Endowment's expense; (b) The Carnegie prize in the book section will comprise a cash award of $1,500; (c) One honorable mention of $250 will be awarded in each category; (d) Should the judges decide that no entry in either category, or both, is worthy of the Carnegie prize, they may at their discretion make special awards or increase the number of honorable mentions.

Disqualifying clause. All present and former employees of the Carnegie Endowment are disqualified from participating in the competition.

PREVIOUS AWARDS

1955. Category 'Books': First prize—Stanley Hoffmann, *Organisations internationales et pouvoirs politiques des États*; Honorable mention—Pierre F. Brugières, *Les Pouvoirs de l'Assemblée générale des Nations Unies en matière politique de sécurité.* Category 'Manuscripts': First prize—David Wightman, 'Economic Co-operation'; Honorable mention—F. S. Northedge, 'Intellectuals and the League of Nations'.

1956. Category 'Manuscripts': First prize—Mohammed Bedjaoui, 'Fonction publique internationale et influences nationales'. Category 'Books': Honorable mention—Romain Yakemtchouk, *L'O.N.U., la sécurité régionale et le problème du régionalisme.*

1957. Category 'Manuscripts': First prize—Jean Salmon, 'Le Rôle des organisations internationales en matière de prêts et d'emprunts'. No other prize has been awarded.

Entries and all correspondence regarding the contest should be submitted to the above-mentioned address.

IV. OPEN FORUM

SOCIOLOGY IN ITALY, AS VIEWED BY AN AMERICAN

ARNOLD M. ROSE

Sociology had an auspicious beginning in Italy.[1] By 1915, criminology had had its great development under the classical school of Beccaria and the biological school of Lombroso and was ready to move toward a sociological interpretation. The 'crowd psychology' of Sighele and Rossi was well in advance of that of LeBon in France, although not so well known to English and German speaking audiences. Niceforo had begun social psychology along sociological lines; demographers had completed many careful scientific research reports for the government; the internationally famous works in general sociology by Pareto and Michels were underway; Toniolo had established the *Rivista Internazionale di Scienze Sociale* en 1893, and the more 'positivistic' *Rivista Italiana di Sociologia* was founded in 1897. Italian sociologists were in close touch with the French sociologists, who led the world in those pre-World War I years. It is quite possible that if Americans had been able to read Italian as well as they could read French and German, they might have ranked Italian sociology on the same high plane they accorded to French and German sociology.

But sociology in Italy died, or—to be more accurate—was deliberately killed. Analysis of the causes and process of this death would make a fascinating study in the sociology of knowledge; I can here but suggest an outline for such a study, and this is marked with some historical interpretation. Of course, not *all* of sociology died, because criminology and demography have continuously maintained a hardy productivity and reputation in academic and research circles. But criminology has continued along the biological path that Lombroso set for it, and has no relationship to sociology either in content or in academic organization: crime is considered on the whole to be an inherited biological disease, and the teaching of criminology is to be found almost exclusively in the faculties of jurisprudence. Demography has had a slightly more independent development, but it is associated not with sociology but with pure statistics and actuarial science. The faculties of law and of statistics provided shelters for criminology and demography while sociology was being suppressed, but they allowed no trace of the parent discipline to be associated with the protected offspring.

There seems to be little question but that the influence of Benedetto Croce was predominant in the academic annihilation of sociology, although Croce was not a professor and he exerted his influence mainly during the era of Fascism, to which he was openly opposed. But Croce was an intellectual giant, the type of broad-ranging philosopher and historian that educated Italians openly worship, and perhaps his attack against sociology in the universities was the more powerful in that he did not have to engage personally in the petty academic battles. Support for Croce during the Fascist era was the intellectual's way of reserving a symbolic independence of mind against the government's fairly ineffectual efforts at thought control. The substance of Croce's attack was implicit in his philosophy of idealism: Man, as a sentient and creative being, was not subject to natural laws, and social science could never be anything more than history. Such a position is well known in other countries, and it still exists in certain philosophical and

1. For some of the early history of Italian sociology see : Franco Ferraroti, 'La situazione degli studi sociologici in Italia', *Quaderni di Sociologia*, N.16 (Spring 1955) and N.19 (Winter 1956), pp. 55-61 and 24-30.

historical circles throughout the world, but Italy had just the right combination of academic and political conditions to make the Idealistic argument conclusive. In their reaction against theology and social philosophizing, the new social scientists identified themselves with positivism, although it is unlikely that they realized the philosophical implications of the Comtean position (just as in the United States of America, few of those who vaguely profess to be positivists, except for George Lundberg, are willing to follow positivism to the philosophic extreme). In Italy today, the fallacious identification of the science of sociology with the philosophy of positivism still hounds the thinking of several of those who might become sociologists, and in Europe generally it is widely believed that American sociology is completely positivistic owing to its emphasis on empiricism.

The control of Italy by Fascism began in 1922, and even though it was mild and ineffectual as compared with the Nazi and Soviet totalitarianisms, it was naturally opposed to free social inquiry and speculation. Further, the philosopher Giovanni Gentile, who broke with Croce on political grounds but remained his faithful pupil in philosophy, became Minister of Education in Mussolini's early governments and one of Fascism's official philosophers. Gentile practically carried Croce's philosophic dicta against social science into effect in the laws and organizations controlling Italy's academic life. Another academic personality was Corrado Gini, who—as chief of the government's Statistical Institute as well as a leading professor at the University of Rome—had great influence over what scientific work there was in the social area during the 22-year reign of Fascism. Gini's role has been a matter of controversy in Italy. There are those who point to his excellent research in demography and statistics, and his founding of the Società Italiana di Sociologia and the semi-sociological journal *Genus*. But there are also those who draw significance from the fact that sociology did not develop during the years in which Gini was the only Italian with the academic, the political, and the international position to develop it; these opponents say that Gini helped to repress potential sociologists and that his Società has always been a paper organization.

Fascism also isolated Italy from intellectual currents in other parts of the world, and among these was the development of sociology in the U.S.A. The Catholic Church, a great intellectual and moral power in Italy, might have been able to neutralize this effect considerably, but the Church apparently was also opposed to sociology until the 1940s owing to its mistaken identification of sociology with positivism. The Università di Sacro Cuore in Milan, however, always supported the other social sciences, and has recently established a seminar in sociology. In the post-war years too, the more official Pontificia Università Gregoriana in Rome has established a chair in sociology, which is now occupied by the competent Padre Pedro Beltraõ, a Brazilian trained in economics and sociology at Louvain. Certainly, since the end of World War II, the Church in Italy has encouraged its higher educational institutions to do teaching and research in sociology.

After the years of confusion immediately following the second world war, signs of the renascence of sociology in Italy began to appear. Today that renascence is in full, upward motion, and it is possible to predict an important future in that country for this previously rejected discipline. Much of the important early development has been outside the state universities, for the structure of the state universities is relatively inflexible and conservative, even at Milan where the tendency is different. There have, however, been a few early signs of change even in the universities. Professor Camillo Pellizzi of the University of Florence, trained in history and linguistics, became a sociologist at the end of World War II when the teaching of the 'History of Fascism' was abolished in Italian universities. Professor Pellizzi has tried to re-establish international contact for sociology, and to open study and research opportunities to his students. In 1957, he is still the only regular professor of sociology in Italy. Professor Bruno Leoni, professor of the philosophy of law at Pavia and editor of *Il Politico*, encouraged at least one of his students to examine the sociological literature in order to publish a regular summary in his journal.[1] This student, Filippo Barbano, became the first 'libero docento'

1. Filippo Barbano, 'La Sociologia in Italia Oggi, Saggio bibliografico', *Il Politico*, No. 3, 1954, pp. 3-40.

(docent available for a chair, if one should become available) in Italy in 1955, and is now teaching and doing research at the University of Turin. Franco Ferraroti was the first young Italian to go to the U.S.A. (University of Chicago) for training in sociology; he is now engaged in teaching and research in industrial sociology at Florence and at Rome. He is also co-founder and co-editor of *Quaderni di Sociologia,* with Nicolo Abbagnano, professor of philosophy at the University of Turin. Norberto Bobbio, professor of the philosophy of law, is another member of the Turin faculty who has been encouraging the development of sociology at that university. In the present writer's view the next chair of sociology at a state university may well be established at Turin.

At the University of Rome, Professor Vittorio Castellano succeeded Gini when he formally retired in 1954. While well known for his works in statistics, Castellano has become seriously interested in sociology since he has inherited the one-year course in sociology, and he is now embarked on the establishment of an institute of social research, with the aid of his assistant, Dr. Eugenio Del Monte. Castellano's first project has been a study of leisure-time activities among youth, and to this study he brings a rigorous training in statistics as well as a growing knowledge of American sociology. Castellano and Del Monte have been hosts to a number of American sociologists, including the present writer. The University of Rome has several others interested in sociology: the statistics faculty maintains a monthly seminar in sociology; the regular professors Franco Lombardi of philosophy, Guido Galeotti of the institute of nutrition, and Luigi Volpicelli of the education faculty, as well as the young social anthropologist, Tullio Tentori and the young psychologist, Luigi Meschiere (both of whom have studied in the U.S.A., are actively favourable to the initiation of sociological research; Rector Ugo Papi—an economist—expresses himself as favourable toward the initiation of sociological teaching. Thus it would not be surprising to see a chair of sociology established at Rome during the next few years.

Another teacher of sociology who is well read in the foreign literature is Dr. Michele Marotta of the political science and law faculty at the University of Cagliari, in Sardinia. This relatively isolated university also boasts one of the most active social psychologists of Italy, Professor Angela Massucco-Costa, who is also editor of the *Rivista Italiana di Psicologia Sociale* and director of the private Istituto Superiore di Psicologia Sociale in Turin. Sociology is also taught as an additional subject by Professor Renato Treves, professor of the philosophy of law at the University of Milan. Milan is also a centre for social psychology: Professor Cesare Musatti encourages it from his position as director of the institute of psychology at the state university; Padre Agostino Gemelli encourages it from his position as rector and director of the institute of psychology at the University of the Sacred Heart; Antonio Miotto, libero docento at the University of Milan, teaches social psychology; the younger psychologists, Leonardo Ancona, Gustavo Jacono, and Marcello Casa-Bianchi are actually engaged in social psychological research at Sacro Cuore (and Jacono has an increasingly sociological orientation). For stimulating sociology proper Professor Francesco Vito, dean of the political science faculty, has been most influential at Sacro Cuore.

Some sociological teaching is to be found at other universities in Italy. The journalism faculty at Urbino offers an occasional course in sociology; Manlio Rossi-Doria, professor of agricultural economics at the University of Naples, could also be identified as a rural sociologist (he and Dr. Gabriele Gaetani d'Aragona have embarked on a long-range research programme in rural sociology); Domenico De Marco, professor of economic history at the University of Naples, gives a strong sociological cast to his historical research; Vincenzo Gueli, professor of constitutional law at the University of Catania, has a strong interest in sociology; Lidia De Rita, professor of social psychology at the University of Bari, was a leader in the first important community study in Italy (at Matera); Eugenio Pennati has been in charge of a course in sociology in the political science faculty at the University of Pavia; Francesco Platzer, professor of agricultural economics at the University of Palermo, brings a broad social orientation to his teaching; Tullio Seppilli is a well-trained social anthropologist at the University of Perugia; Innocenzo Gasparini, professor of economics at the University of Venice, has been moving toward a sociological orientation through his research in urban development.

Most of these teachers are self-taught in sociology or social psychology (psychology was almost as badly devastated by the Croce movement as was sociology, except that it received some protection in the medical faculties). Naturally, owing to their lack of precedents and long isolation and difficulties with foreign languages, many have not known what to read among the vast plethora of sociological writings. Most of them could not benefit from each other's experience because until the year 1957[1] they had no functioning national organization and probably most of them did not know of each other's existence (each believing he was creating sociology in Italy *di nuovo*). There is still but one chair of sociology in the more than forty state universities and four private universities, and only two or three others devote themselves exclusively to sociology. Sociology is still a supplementary field in Italian universities, and the rigidity of the structure of the university system as well as the scattering of the typical professor's interests (most professors in Italy have several positions, in order to build up their incomes to a respectable level) will tend to keep sociology on the margin for a long time to come. Sociological research by these academic men is even rarer than sociological teaching.

In the meantime, the post-war era has seen a rapid flowering of sociological research, mostly of an applied or practical nature. The end of the war and of Fascism found many Italians self-conscious of themselves as a nation, painfully aware of their areas of backwardness, and usually quite willing to borrow from abroad what seemed 'modern' and useful. Many individuals and organizations discovered that it was valuable or even necessary to study whatever social condition it was that they were interested in before they could take rational steps toward effective action in pursuit of their goals. The result has been a flowering of all social science research, including all the practical types of research closely associated with sociology. Again, the research was done by self-taught men, with a few exceptions of individuals who were able to study abroad, and the main teachers have been American books and trial-and-error experience.

Naturally, market research was the first to develop, and the market researchers often branched over into general public opinion research. Already in 1946, the statistician Pieropaolo Luzzato-Fegiz, professor at the University of Trieste, established DOXA as the Italian affiliate of George Gallup's American Institute of Public Opinion. His chief assistant is Dr. Mardessich, also trained as a statistician. A thick volume of findings of general interest was published ten years after the founding of this public opinion and market research agency.[2]

Ernesto M. Norbedo broke away from DOXA and established the rival Istituto Italiano dell'Opinione Publica, with an office also in Milan. His chief assistant has been Gabriele Morello, who studied economics at Stanford University and picked up enough sociology to turn a few of his public opinion studies into excellent researches of general sociological interest. In 1957, Morello shifted his major activity to that of director of a new school for junior executive businessmen at Palermo, called the Istituto Superiore per Imprenditore e Dirigente d'Azienda (ISIDA).

Milan has a full-time private university for training businessmen—the L. Bocconi Commercial University. It has a Centre for Operational Research which includes several competent social researchers. Among the group are its director, Professor Francesco Brambilla, Alessandro Pizzorno (who formerly did industrial relations research for the Olivetti Company) and Angelo Pagani (who also works in a home for the aged in Milan and has done some highly competent research on the sociological and psychological problems of the aged). Milan has another school for young businessmen, the Istituto per Adrestamento nell'Industria, but it is not known to sponsor any sociological research. At the Istituto Post-Universitario per lo Studio dell'Organizzazione Aziendale (IPSOA) in Turin are to be found several industrial sociologists engaged in research and teaching, for instance Anna Anfossi and Magda Talamo.

The Olivetti Company (typewriters, calculators, etc.) with headquarters at Ivrea

1. In 1957 the Associazione Italiana di Scienze Sociale was formed and held its first organizational meeting in Bologna.
2. *Il Volto Sconosciuto dell'Italia*, Milano, Dott. A. Giuffré, Editore, 1956.

has its own Office for the Study of Social Relations, now headed by Ferdinando Orlandini, who formerly did rural social research in southern Italy. Associated with him are Carlo Doglio and Luciano Gallino (the latter has written a competent essay on the sociology of literature). Adriano Olivetti, the head of the company, has strong interests in social research, social welfare, and political change. In addition to maintaining this office for industrial sociology and helping to sponsor IPSOA and the Bocconi University, he helps to sponsor the independent industrial sociological research of Franco Ferraroti (mentioned earlier as an instructor at the University of Florence), the research on communities and co-operatives of Albert Meister (whose Centro di Sociologia della Cooperazione at Ivrea is an affiliate of the international movement headed by Henrik Infeld), and the semi-popular periodical, *Communita*, for intellectuals who are interested in social welfare.

A few other businessmen employ research workers in industrial relations for their companies, but their work is often narrowly limited to the purpose of increasing productivity. The Fiat automobile company helps to sponsor IPSOA with its broader research programme, and a large number of businessmen are to be found among the sponsors of the other schools for junior executives mentioned earlier. Another private businessmen's organization of considerable significance is SVIMEZ in Rome: its purpose is to stimulate the industrial development of southern Italy and the islands (collectively called the Mezzogiorno). It has accomplished a considerable amount of solid economic research, and recently it has formed a sociological section consisting of Drs. Sebregondi, De Rita and Salviucci. Research in the rural sociology of the Mezzogiorno is also sponsored by government development organizations, such as the Cassa per il Mezzogiorno (with which Professor Rossi-Doria has been connected), the Consorzi Riuniti di Bonifica at Oristano in Sardinia, the Ente Trasformazione Fondiari Agraria per la Sarda at Cagliari, in Sardinia, and other regional organizations. None of their employees could be said to be sociologists, but some of their economists, geographers, and social workers could be said to have sociological orientations. Some of the government-operated industries have employed part-time sociologists to study industrial relations problems (for example, Ferraroti and Jacono are studying the shipbuilding yards at Castellamare and Naples), and in their central offices in Rome are to be found philosophers and social scientists with sociological orientations, for instance, Felice Balbo, Gino Giugni and Giorgio Sacco. The Gulf Italia Company, a subsidiary of the Gulf Oil Company of the U.S.A., has been in contact with Morello to do a study of social changes and social problems in a small Sicilian town where oil has been discovered.

For several years the American political scientist, Sebastian De Grazia, conducted a successful business in industrial relations and other research for private businesses and government agencies. The well-known 'community study' of Matera—which highlighted the social problems of agricultural development in the Mezzogiorno, and on which such Italian social scientists as Lidia De Rita and Tullio Tentori acquired research experience—was also started by an American, F. G. Friedmann, professor of philosophy at the University of Arkansas. Paul Campisi, sociologist at Washington University, did a community study of Ivrea, using Italian assistants, with the partial sponsorship of Olivetti. On a more individual basis, Lowry Nelson of the University of Minnesota studied land reform in the Mezzogiorno, Carl Zimmerman of Harvard University and Stephen Cappannari of Wayne University did community studies. With the aid of students at the ENSISS school of social work in Rome, Leonard Moss of Wayne University studied family life in Rome, and with the aid of students at the University of Rome, the present writer studied social integration in an old and a new community of Rome.

Political interests have played a small role in developing sociology. Several political parties have intellectuals in their employ, and a few of these have a sociological orientation, but politically oriented sociology is found for the most part outside the parties. Mention has already been made of Olivetti and his semi-political Communità movement (not far from the Social Democratic party). There is a group of openly Communist intellectuals, and another leftist group publishes the journal *Ragionamenti*, and a few individuals with sociological interests are included in these circles. Some of

these hope to use sociology to provide a 'scientific basis' for their political doctrines.

Sponsoring practical sociological research is the Genoa city government, now dominated by Christian Democrats, which has established an Ufficio di Studi Sociale e del Lavoro. It is a five-man office, headed by Luciano Cavalli who studied political science at Columbia University for a year and picked up a considerable knowledge of sociology. This office is studying the problems of migrant workers from southern Italy, and the attitudes of workers toward the government-owned shipbuilding yards in Genoa. The Venice city government, faced with a serious problem of urban development in a city which has perhaps the most unusual geography in the world, has employed Professor Innocenzo Gasparini to study its problems, and he has found it necessary to move from economic to sociological aspects of the situation.

A potential centre of sociological research, but one which has not yet fulfilled its promise, is the Istituto Luigi Sturzo in Rome, named after and generally directed by the famous founder of the Christian Democratic party. It has probably the best library of sociological works in Italy (in all languages), but this is little known and less used. To date the institute has held several prize contests for essays on sociological and historical topics, and it has published a periodical, the *Bollettino di Sociologia*, edited first by Vincenzo Filippone and now by Mario d'Addio. There is room, however, for many other activities. Don Luigi Sturzo himself has published many philosophical and historical works with a sociological orientation and has stimulated others to become interested in sociology, but he is now very old and devotes most of his energy to politics.

In addition to the many individuals associated with academic, private, or governmental organizations having some kind of interest in sociology, there are several individuals who have no connexions of this sort but who should not be overlooked because they are making valuable contributions to sociology. In the spare time he can get after fulfilling the requirements of a fairly routine government job, Luciano Potestà of Rome has made himself familiar with the literature on industrial relations research from all over the world and contributes regular articles on this to the journal *Problemi Umani*, of which he is a contributing editor. Giorgio Braga of Turin has published a sociological study of Communism. Charlotte Busch of Rome has been studying sociology on her own.

A special word needs to be said about the sociological interests of those whose primary interest is in social work or social welfare. Mention has already been made of the excellent research on the sociology of old age done by Angelo Pagani (some of which has been published in the journal *Longevita*); Pagani also teaches in the UNSISS school of social work at Milan. The sociologist Ferraroti gives lectures at the CEPAS school of Rome (directed by Dr. Zucconi); the social anthropologist, Tentori, and the social psychologist Meschiere, give lectures at the ENSISS school in Rome (directed by Monsignor de Menasco). At the latter institution also, a young man, Dionisio Martino, has been studying American sociology so that he could give lectures to the social work students. Dr. Carla Cortese, director of the Scuola Superiore di Assistenze Sociale of Genoa, is friendly toward sociology, but has no one teaching the subject in her school. There is a unique national private organization with headquarters in Milan, the Centro Nazionale di Prevenzione e Difesa Sociale, which seeks to promote social welfare through improvements in law and law enforcement. Especially concerned with juvenile delinquency, the Centre has many prominent lawyers among its members and Judge Adolfo Beria di Argentine is its general secretary.

One of the startling things about Italian sociology is that, despite its weak and marginal position, it boasts more journals in the field than any other country, including the United States where there are some 4,000 full-time sociologists. These journals have grown up partly to meet some special need and partly because their founders were not aware of the existence of other journals already in the field. Because of the slight development of the field itself, its journals are necessarily weak in content, although there are occasionally superior articles, either reporting research or surveying a special subject matter. Mention has already been made of the general journals: *Genus*, edited by Gini; *Quaderni di Sociologia*, edited by Abbagnano and Ferraroti; *Bollettino di Sociologia*, edited by D'Addio of the Istituto Luigi Sturzo; *Il Politico* (with its annotated bibliography in

sociology) edited by Leoni; *Problemi Umani* (with its emphasis on industrial and work problems) edited by V. Lupo of Rome; *Communità* (with its general political-social improvement orientation) edited by Olivetti; as well as the specialized journal *Longevita*, dealing with the problems of old age. Another journal which seeks to be sociological while it attracts an audience of general intellectuals is *Il Mulino*, edited by Fabio Luca Cavazza of Bologna. Associated with the journal is a small publishing house of the same name which publishes mainly translations of American works, such as the textbook in sociology by Rumney and Maier, *The Lonely Crowd* by Riesman *et al.*, and is now working on the essays of Parsons and Merton. Another relevant journal is the *Bollettino di Psicologia e Sociologia Applicata*, edited by Eduardo Abbele of Florence, under the supervision of the psychologist Marzi and the sociologist Pellizzi. Cavalli of Genoa is planning a new journal in industrial sociology. In social psychology there is the *Rivista Italiana di Psicologia Sociale*, edited by Massucco-Costa. There are other journals which occasionally publish articles of sociological interest, such as *Tempo Presento*, *Ragionamenti*, *La Civiltà Cattolica*, *Architettura*.

There are numerous obstacles to the development of sociology in Italy, apart from the resistance of the universities. There are remnants of the old antagonism to sociology, especially from certain philosophers and other humanists, and the identification of the science of sociology with the philosophy of positivism, on the part of both friend and foe. There is an over-optimism about sociology, associated with a great confusion as to what sociology is and can do, and in reaction to this mistaken optimism there may develop an equally mistaken pessimism. The political struggle in Italy pervades even the academic halls and tends to force all to choose sides; it prevents some potential sociologists from perceiving that there can be an objective science of society apart from political values and dogmas and it prevents some capable persons from working together for a common scientific goal. A struggle is also taking place among the established social science disciplines to house the developing sociology or to kill it before it becomes a threat to some special disciplinary interest. Sociology is taught in the law faculties at Milan and Cagliari, and is combined with statistics at Rome, political science at Florence and Sacro Cuore and with education at Torino. It is undoubtedly difficult to keep up to date with and understand the voluminous foreign literature and, in Italy as in several other countries, there is the danger that one particular point of view in sociology—especially one that is being well advertised, like group dynamics—will become identified with the whole discipline and stifle research in other directions and on other subjects. Finally, there is a great deal of sheer opportunism among certain would-be sociologists who care very little about a science of society and human relations, but want to get in on what promises to become a paying activity which carries with it a good deal of prestige.

Thus, there seem to be many indigenous forces both favourable and unfavourable to the development of sociology in Italy. One other general influence should be mentioned which encourages optimism: Italy is a vital country with many social problems pressing for sociological investigation; the need is shaping the tool. At the moment, the position of sociology is fascinating to examine because it is pregnant with all sorts of possibilities and it is changing rapidly.